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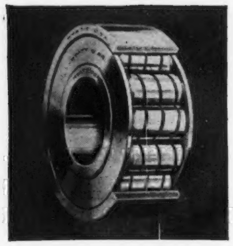

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Organization of a Modern Diversified Farm[1]

By A. B. Van Schoik[2]

THE idea of the organization of a large-scale farming corporation was suggested to me by three or four different conditions that I had observed in my work as an operator of two large farms, as a rural pastor, and as a county agricultural agent.

As an operator I was compelled to carry too high an overhead in equipment and found it difficult to manage my labor throughout the year so as to get a profit from such labor. True some industries do not employ men continuously through the year, but there can be no question but that the most efficient help is the man who follows the work through the year. I had observed that certain men are not equally well adapted to do all kinds of work on the farm, that is, some farmers are very good animal husbandry-men, others are good mechanics, some are good salesmen, while others are very indifferent in that art.

Under the old system every farmer is expected to be a combination of all these in one. Under the ideal system of large-scale operations the man most adapted for a particular line of work will be given that work to do. The average modern day tenant is not a prospective landlord; he is not much more than a squatter on the land, a sort of migratory bird that flits from farm to farm robbing the soil and society and getting but a poor living. Some time back some statesmen and leaders of farm organizations began to make a noise about the operation of large-scale farms in the Great Plains, these farms being operated by individuals or corporations. It seemed to me that, if such a method was advisable and economically sound there, and they were as able as they have since proven themselves to be, the agriculture of the old settled communities must undergo an evolution of its methods, or those farmers must become marginal producers who will eventually be forced out of competition.

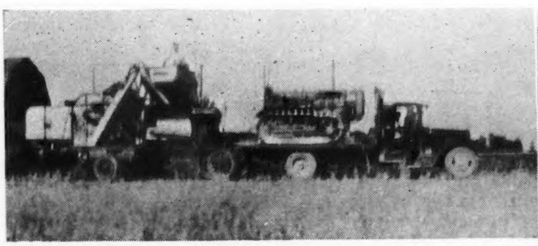
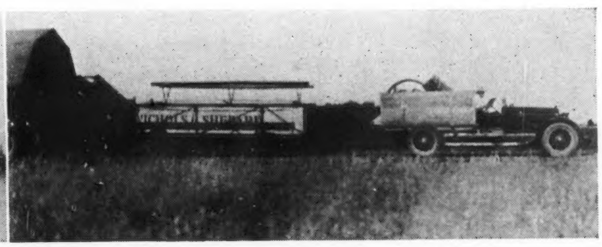
That thought is only three years old as far as I am concerned, but within the last four months one bank has foreclosed well onto two hundred farms and only taken over those farms where the farmers were beginning to destroy the farm buildings for fire wood.

Here is an illustration of the condition. Last year while attending this meeting three of the members made the statement that they could produce wheat at 50 cents per bushel with a profit. In lecturing to a college class later I made the statement that "wheat will sell this season for less than 90 cents per bushel and these same Great Plains producers can and will force the eastern farmer to produce wheat for 80 cents per bushel or go out of business." It has beeen selling for less than 80 cents, and these farmers are still trying to grow it. The result is both obvious and inevitable. The fact that industry has begun mass production makes it mandatory that agriculture follow suit.

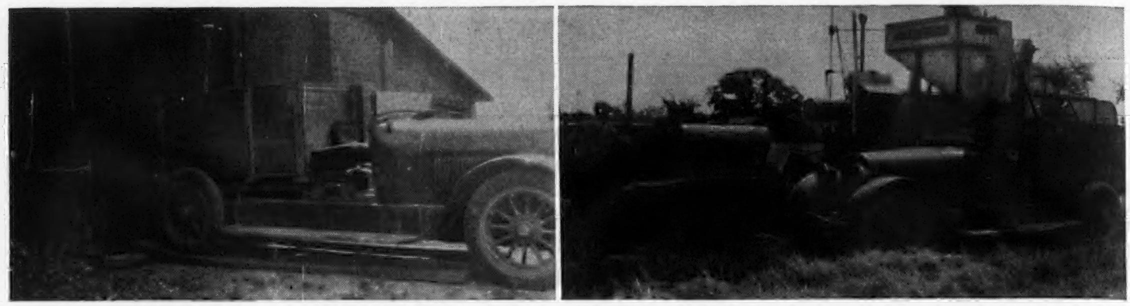
Almost every farmer will admit that, if farmers could work together, they could very materially cut their costs of production. The difficulty in the way of such operation has been that, where two or more farmers attempted to work together, they expected or demanded that the operation should be carried on on their own farm at the opportune time, the reason being that the return came to the individual from his own farm and not from the entire operation. It would seem, therefore, that it were better to form some kind of a corporation, the various landholders and tenants putting their land or equipment in as so much stock. In practice it does not work because the average farmer is not familiar with business as thus carried on, and he suspects that he may be defrauded, or he just wants to be independent of his fellows, even if he must carry on at a loss.

Personally I have little hope of getting the average farmer to operate his land in this manner, until he has been forced out by financial difficulty. Those most interested in the organization of a corporation of this kind are the business men who may own land or who because of their business experience have seen the weakness of the old method and the advisability of the new. Bankers and insurance companies who see the handwriting on the wall are interested but difficulties present themselves there. Under the existing banking laws the banker must dispose of his foreclosures or charge them off his books, and the insurance company wants the land as a security and not as an operating proposition or investment. It would seem that there will have to be some new methods or policies adopted in respect to lands which are already

[1]Paper presented at a meeting of the Power and Machinery Division of the American Society of Agricultural Engineers, at Chicago, December, 1930.
[2]General manager, The Farms Operating Corporation.

(Left) Mr. Van Schoik uses transport trucks to haul combine equipment, including both combine and tractor, from farm to farm. (Right) He built a special header table trailer fitted with rubber-tired wheels. This he can haul behind a grain truck at a speed of 35 miles an hour



Two views of grain trucks on the properties of The Farms Operating Corporation unloading at the company's elevator and loading at the combine

held by these institutions. This may be done by a holding company being formed for the purpose of operating for a profit.

The ideal set up as to finance is one in which sufficient capital is available to insure operation over a number of years, for while a single year's returns might be of such a nature as to invite capital into the proposition as an investment, it is more than likely that it will take from one to three years to produce any return in the form of dividends. It is not necessary, nor do I think it advisable, to have available paid-in capital for three years operation, but it is advisable for the stockholders to be able to assess themselves to the amount of three times their original stock. The amount of capital necessary for such a corporation of course depends upon the size of the unit to be operated and that is determined by more than one condition. In a diversified farming operation what disposition of the products is to be made and the plan of management will be the determinants.

For example, if the products are processed in some way, that will be regarded as intensifying the production and the acreage need not be so large. But if, for instance, the grains were to be sold as seed and the cull grains, screenings and roughage were fed through livestock, there should be about 2000 acres. If, however, the grains are sold in the open market, then the acreage should be increased in multiple of that, or the management of an experienced, reputable agricultural service should be employed. The reason is that the management should be of superior training to that necessary for the qualifications of the field foreman. The proposition will not carry the overhead of a foreman and that of a general manager who gives all his time to the business. In other words, management should not cost more than one dollar per acre. The man who is really capable of the management can as well manage 10,000 acres, or five units of operation. If, however, the processing of the products of the field operations is increased rapidly enough, the number of acres under one management can quite materially be decreased.

The land in such an operation should, preferably, be of the greatest fertility and lie close together. This is not as necessary, however, as would at first seem advisable. The county in which our farms lie is 24 miles from north to south. We have farms within 1½ miles of the north county line, and within 2½ miles of the southern boundary. This gives an advantage as to rainfall. At the north we had enough rain to produce a fair crop, while at the south we had not enough to sprout the corn after it was planted. There is a ridge which runs diagonally across the county from northeast to southwest. This is the old lake shore. Within the memory of men now living this eastern part of the county was covered with water a part of the year. It has a very flat surface and is fertile, but much of it is not yet satisfactorily drained and does not lend itself to the production of winter wheat. North of this range we have clays of the Miami and Hillsdale type and sands of the Berrien and Fox type. These may be handled in the spring of the year from one to three weeks earlier than those south of the ridge, except where the latter are underdrained every three to six rods apart. We are able therefore to carry on our preparation of the soil and planting of the crops over a much longer period than if the soil type was the same on all the farms. These northern farms are not primarily good corn farms, but they do produce excellent crops of small grains, while the heavy farms in the lake bed area are primarily corn farms competing favorably with Illinois farms. Varying conditions require a different system of management which lends itself to the better use of equipment than if they were all of the same type. However, the ideal set up would require the land to lie in units of about 500 acres, having, in the aggregate, about four of these units, or 2000 acres altogether. These groups of different soil types should be widely enough separated to minimize the risk from local drought, hail, and even frosts due to different air currents.

EQUIPMENT ADVANTAGES

One of the greatest economies of large-scale operation in diversified farming is in the use and type of equipment. We can venture the statement and back it up with fact that we are able to use a combine to greater advantage in the East than is being done in the Great Plains area. This season we harvested 1200 acres of crop with one combine, a 16½-foot machine, and had the season been favorable for the setting of soy beans we would have increased the harvesting acreage quite materially. In other words, it is quite possible to harvest as much as 1500 acres in one season with a machine of this size. The first year we used this machine we transported it on its own wheels. This necessitated about two hours time to tighten up the nuts that jolted loose, and the time, when it was necessary to move it as much as 12 miles, was prohibitive. This year we put it on transport trucks that required about 30 minutes for placing. We then loaded the tractor on a truck, hooked the combine back of the truck, and took the road at 18 to 20 miles an hour. The header table trailer was fitted with rubber-tired wheels. We attached it to a grain truck and took it with ease at 35 miles per hour. In fact we were but little longer on the road with this outfit than the average tractor-drawn threshing outfit in the community.

Two types of tractors are adapted to our type of operation. Those are the tracklaying type and the general-purpose type which are used for cultivating. The principal reason for choosing the make of general-purpose tractor we use, is the quickness with which we can secure parts. We can have any part required for repair within 2½ hours from the time the tractor is out of service. We have another cultivating type tractor that we like very much, but it has been out of service 60 days because we cannot get the repair. It would seem advisable to use just

such equipment as has been so standardized as to make repairs readily available.

Much of the farm equipment we now find on the market is not too satisfactory for use in large-scale operations. Of course, the criticism is not new, but I want to advise again that the machine manufacturers have a lot of work ahead of them to meet the requirements of this new method of production. Practically all the farm equipment we are now using is really horse equipment fitted with tractor hitches. We are using a tractor plow that cost us $256, and necessitated $235 worth of repairs and points the first season. The shares on this plow are no heavier than those used on the single-bottom plow of the same make. When the plow point strikes a stone, the point must carry a ton of plow in addition to the weight of soil it is turning. The strain is too great and the point breaks. We are using a disk harrow that cost us $400. This tool has cost us scarcely nothing for repairs. While the original cost is quite high, yet the upkeep is very low and will cost much less in the long run than one of the ordinary disks.

The use of tractor cultivators was new to me, but taking the experience of an Illinois farmer I ordered a four-row cultivator, but was unable to get anything but a two-row cultivator the first year. This year we secured a four-row cultivator which we operated to our entire satisfaction. In two days we cultivated 150 acres of corn, the corn being a little more than knee high at the time. The tractor was driven 16 hours a day, the drivers working in two 8-hour shifts. As a boy I thought I had done quite a day's work when I had cultivated seven acres in one day. The field of my boyhood activity contained just seven acres, while the one in which we were cultivating this season was 187 rods long. However, the two day's cultivation was in four fields and a distance of 3 miles lay between the two farms.

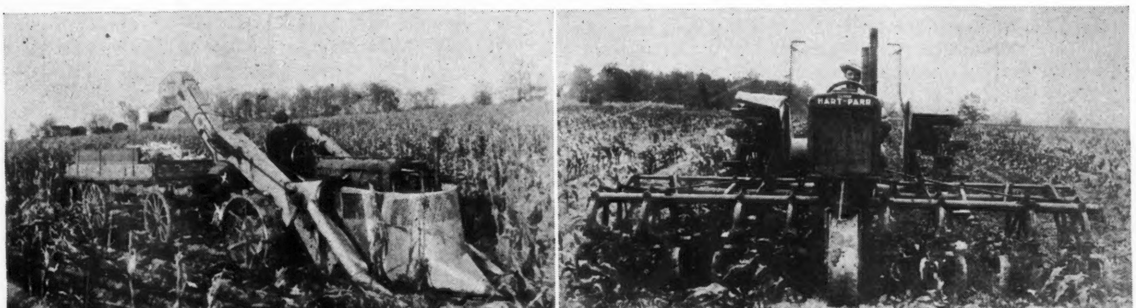
Much new work is ahead of the manufacturers and the farm manager of the eastern large-scale farm. For instance, the straw on fields that we were unable to save this season was worth $2000. The head of the agricultural engineering department of Michigan State College (H. H. Musselman), the manufacturer and myself worked out a plan to save this straw only to find that the combine lacked separating capacity to handle the amount of straw necessary. This problem must be met and solved if the combine is to be used in the East to any great extent. Unquestionably it will be done but these developments require time.

We are in the center of the corn-borer infested area and we are expecting that, when we have moisture enough to produce a bumper crop of corn, we will produce borers enough to destroy the crop. In the mean time most of our neighbor farmers think that the borer scare is a huge joke and are doing nothing about it. We know from experience that it is possible by clean farm practices to control the pest, but the cost of a real clean-up is enough to discourage many farmers. If the labor charge of the clean-up could be met in some way, much of the aversion to it would be overcome. We know a way that that can be done for already there has been built a machine that will cut the corn, husk the ears, shred the fodder and put it into a bale; the whole done in one operation. We have a paper mill at the center of our operations that would transform their plant into a cornstalk pulp plant, if they were guaranteed the stalks at a price that would allow their use in competition with other materials. This also must be done, but much water will have passed under the bridge before it can be accomplished.

As to the number and size of tractors and other equipment necessary to operate a unit of 2,000 acres or larger, the answer is purely a matter of mathematics. To get the maximum capacity of the machine, the working hours per day should be increased. That is, if there is thirty days in the period of preparation for planting corn, and weather conditions prevent work for half that time, tractor capacity can be doubled by doubling the shifts and operating the tractor 20 hours a day instead of ten. It is not safe to plan the work so that the tractor hours required are equal to 20 hours a day continuous time. In the use of the combine the length of the day cannot be increased beyond a certain point because of dew. This season our combine started July 14 and operated forty consecutive days. The crew was on the job from twelve to fourteen hours a day. To keep up the efficiency of the men we shifted so that each man in the outfit had one day off in ten. The operation of a large-scale farm is necessarily a tractor power proposition.

LABOR

The men employed must be of such ability that they can be entrusted with the care of machinery and the carrying out of the operation. Our first demand of an employee is that he obey orders. Our second demand is that he go beyond the orders and use his own judgment where the operation requires a change in the plan. The reason for such a demand is that the farm foreman cannot be present continuously, as can the foreman in a factory. Suppose, for instance, the foreman visited the field in the morning, started his operation and then went to another farm, perhaps not to return any more that day. Conditions might arise that would necessitate a change of equipment. It is necessary for the operator to have initiative enough to make this change. Older men who have had considerable experience are more able to make these decisions. However, most of our older men have "horse" habits. That is, they have used horse-drawn equipment in fields that should be known as "horse size" fields, being originally laid out on the assumption that a horse could walk so far without resting. So that the older men are very apt merely from habit, to find some excuse for stopping the tractor when there really is no reason for it. A few men in the group should be young, for the operations on a large-scale farm make it necessary to operate the equipment at night. Young men do



(Left) Mr. Van Scholk uses a two-row corn picker with his general-purpose tractor. (Right) This past season he used a four-row corn cultivator with complete success

not mind being out nights, but older men can think of numerous reasons why they cannot work nights.

The management will meet with the innate prejudices of employees against the use of various kinds of modern equipment. For instance, the use of the chisel, or, as Dr. Nixon would say, the "jostler," met with decided disapproval because none of the men had ever seen this tool used. Therefore, it could not possibly be a desirable tool to use. We chiseled 40 acres of ground for corn, part of which was a blue grass sod. It had been treated to a coat of manure, and when an older man was instructed to use a corn planter he stopped work at 4:00 p.m. because he thought he could not plant corn on ground thus treated. The following morning a young man who didn't care was put on the corn planter, and to the astonishment of the entire force the corn grew as well or better than on plowed ground.

It will readily be seen that the type of hired man we used to see on so many farms, almost if not quite subnormal, has no place in the organization of the large-scale farm. He will be of the better type employed in industry. This criticism applies to the east where all the men, or practically all the men, who had any ability went to the city and worked in the factory, leaving the inferior type on the farm.

TRANSPORTATION

The question that seems to be uppermost in the mind of our observers is the cost of transportation of equipment and of men from farm to farm. There is no question but that this should hold attention, but it is not as serious as it might seem. The cost of a 2½-ton truck is $2500. The upkeep is $450; driver, $1000; interest, $150; tax, $75; gas, $250; depreciation, $250; oil, $30—total, $2205. In other words, it cost us $5.00 over $1.00 per acre to operate our truck this year and that includes the trucking of all livestock and grains. The average farm of Michigan contains 90 acres. We are operating twenty-four such farms. This is less than $92 per farm for transportation.

There is one item in the above costs, to which I wish to call your attention, for we, out of personal experience, have no way of computing the cost of upkeep. The superintendent of maintenance of our county roads has a very complete set of records and informs me that the average upkeep on his trucks operated over a period of twelve years is $450 per year. It may be interesting to you to know that we have tires on our truck that have carried it more than 40,000 miles. Some of the operators of the public utility truck lines trade in their tires at the end of each year. We find it to our advantage to wear them out. Another feature of our transportation is the use of various kinds of trailers. These cost us very little as they are salvaged from the junk yard as old iron and constructed in our own shop at a very low cost. A four-wheel trailer cost us $160. Two-wheel trailers cost us about $40 each. We load a 16½-foot swather bodily on the four-wheel trailer. This may not mean much to some of you, until I explain that it is 24 feet long one way and 16 feet the other. The problem of transportation is after all not so great.

The marketing of the products of a large-scale diversified farm could not be the same if there was any great number of them, but until the time when they are more numerous than at the present, there will be readily available markets for specialized products. We are large growers of certified seeds which we market through seed houses. We are growing for two of them and have not been able to satisfy their demand as to quantity. They have been very much pleased with the quality of the product which we produce. In this system of management the cull grains, roughage, etc., are marketed through livestock. Being large producers, we have certain advantages which obviously come to those who are able to buy and sell in large quantities, being able to get the same prices as the local elevators. We avoid any difficulty with these organizations by having them as stockholders in our corporation. On some products we pay them $5 per car for the use of their name as the shipper. The finding of the market I wish to discuss later.

One of the most difficult problems in this organization is that of accounts. The regular bookkeeping of course must be set up in very acceptable manner. The system is as important to this organization as to any industrial corporation and should be in the hands of a good accountant. The records that have to do with the field work are most interesting and should be given the greatest attention because the field is new and there are few precedents to go by. Our own system helps us get the facts very well. Each employee is furnished a daily time sheet or card on which the various facts of the work are entered. At the top of the card is a space for the number of the farm and the letter of the field, the date and the operator's name. Below is space for enterprise, number of the machine being operated, and after each the number of hours of work for the machines and the operator. This makes it possible to determine within thirty minutes how many man-hours or machine-hours are required for any crop or activity. The system is very elastic for we are able to study individual men, farms, crops, machines or any particular phase of work. This time card is turned in each week for with our scattered activity it is not possible to collect them daily. The men's time is checked in the time book, and then the card is copied onto a weekly sheet where the totals for the various machines are netted at the bottom of the page. If I want to know how many hours of labor were expended on the corn crop, the office girl can determine it in a few minutes, and as the season progresses this totaling is done and filed. A chart can then be made to study the various activities with the purpose of expediting the work, or as the bases of plans for future activity.

Since the organization of this corporation we have consistently lost money, and our charts tell us where the difficulty lies. We find that it is not so much the cost of production as it is low production. The low production was caused by very unseasonal conditions over which we have no control. I have been an interested student of the work of the Department of Farm Organization and Management of the University of Illinois, as well as that of similar departments in other states. The average for the production of corn on Illinois farms was 13.8 man-hours, while ours have averaged but 7 man-hours for two years. Such an analysis of these problems is not possible without some accurate system of records.

RENTAL SYSTEM

The first year in which we operated was the season of 1929. All our land was rented or leased, some of it on a cash rental basis and some of it on a share rental basis. The landlord in many cases lived on the farm and some of them entered our employ. We soon discovered that the share rental farm could not be handled satisfactorily to the owner, due to the fact that he wanted to inject into the management the time of performing the phases of work. As far as we were concerned the return from one farm was as valuable as from another. It was therefore a matter of when we could do the work to the best advantage, as to transportation of equipment.

A cash rental system is best adapted for large-scale management. We are not interested in the purchase of land until such time as the real value of the land is appreciated by the present owner. The diversified farm can be made to handle any crop that readily lends itself to machine handling and finds itself a place in the order of work that makes it possible to move the major portion of men and equipment from task to task and crop to crop.

Our system provides no place for the production of hay, the reason being that there is no interim where this work may be done, and also that the average small oper-

ator can do the work about as expeditiously as we can. However, we are looking forward to the time and that in the near future when we can put a crew of men and equipment to work early in June and continue them at the making of alfalfa hay until frost in the fall. We expect to dry the hay as it is taken from the windrow and put it into bags ready for market. Don't ask me how we are going to do it, but I know we are going to do it, and at a cost that will make the present system of artificial drying look like a very crude and expensive operation.

At this point I want to make some observations concerning my idea of the ideal manager for this system of farming as applied to our older settled communities. The old prophet said "where there is no vision the people perish"; and I agree with him that the first qualification of the farm manager is vision. His mental machinery must be so constructed that he can readily see years into the future to visualize as far as he is concerned the general program. He will of necessity be compelled to visualize the procedure to a skeptical world about him. Any stockholder before he becomes one must have the field visualized for him. In fact, all who come in contact with him must feel him to be a sort of dynamo that charges them into an active personal relationship to the whole problem. He can not do this without having that quality known in nice society as "intestinal stamina." In fact, to quote Scripture again his motto must be "This one thing I do, I press forward." When the weather blows up and the machines break down, when crops are poor, the markets bum, the manager must be looking forward. By this I mean that, while he is perfectly cognizant of all the difficulties, his program must be constructive. He may have to make a few strategic retreats, but he will be planning a new attack while he is doing it.

Now agricultural colleges are planning courses in farm management, but the successful farm manager will have a background that is broad and an acquaintance with the field of agriculture that will give him a fund of resources for the task before him. It will be broad in the sense that his acquaintance is broad—I mean his contacts with men who are engaged in work that may be of benefit to him in securing markets or counseling him in carrying on his work.

This meeting is like a rail fence between two farms; the farm manager who would succeed must meet here to discuss with his "neighbors" the problems that are of mutual interest. The world has shrunk until it is necessary for the farm manager of Michigan to be conversant with what is transpiring in the agriculture of Russia and South America.

Management of large-scale operations is necessarily an engineering proposition and as such requires the man who succeeds to handle all the elements in a technical manner. That is, he must have a creative mind which readily works out schedules of materials and men. He must have a sense of values that will enable him to put first things first. I am not trying to teach a course in administration, but if the farm manager has not ability as an executive, he will not succeed in his chosen field. While vision may be the first requirement of the farm manager, the last one I wish to point out is none the less of extreme importance. He must have the scientific approach, by this I mean he must seek for the truth with an analytical mind, and when the facts have been presented, accept them for use. This may be illustrated by a personal experience. Four years had been spent in the development of a variety of corn. Farmers, preachers, school teachers, students and state officials had given much time to the work. It was finally given to a seedsman for the increase work. The same year it was planted in variety tests where it outyielded by several bushels its nearest competitor; but the seedsman had junked the entire product of the increase plot. He was not scientifically minded.

The organization of a modern diversified farm is the work of one man bringing together the requisite factors of finance, land, equipment, and personnel to function for the purpose of putting the balance in the black rather than in the red.

The Zuider Zee Reclamation Project

By Dr. W. L. Powers[1]

FOR several centuries the Dutch people have been patiently pushing back the sea and recovering land from the domain of Neptune. With a population of seven and a half million, or more than one person to the acre (which increases 100,000 a year), and of which 53 per cent is rural, Holland's way to expand seems to be toward the sea.

Plans for the reclamation of Zuider Zee took definite shape in 1887; the work was decreed in 1918, after exhaustive surveys and studies of tidal action, and may require 20 to 25 years to complete. When I visited it September 1, the northwest unit, 50,000 acres, had just been unwatered, and the former sea bed was still a mud flat. This unit is closed by an 11-mile dyke running northerly from Medemblik to Den Oeven, and is served by two pumping plants. The main dyke is to be closed in approximately two years, and will extend across the neck of the sea from Oeven northeast 18½ miles to Harlington on the Fresian Coast. Three other districts, or "polders," will then be enclosed bringing the total reclaimed area up to about 550,000 acres. The Zuider Zee will be reduced to 270,000 acres, and become a fresh water settling and storage basin for the Yssel River, which is a delta branch of the Rhine.

Sluices and ship locks will be required in the dykes, as well as pick-up channels along the former shore line where established drains and pumping plants now discharge water. At the west end of the main dyke three sets of sluices of five units each are being built, while two sets of five portals each are going in at the other end. The portals are each 40 feet wide and 165 feet long, with mud sills 14 feet 5 inches below normal Amsterdam water level. A set of tide gates and two sets of sluice gates is being provided for each unit.

Locks at each end of the main dyke are being made 46 feet wide and 470 feet long, while a secondary lock at the east end 30 feet by 230 feet is being provided for smaller craft.

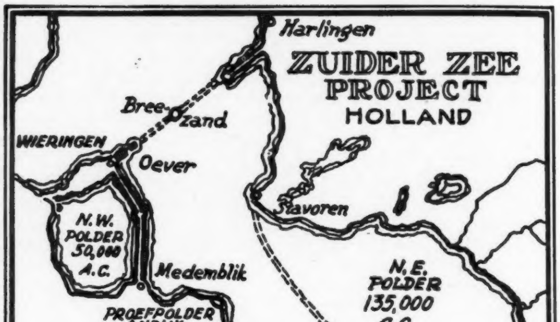
[1]Soil Scientist, Oregon Agricultural Experiment Station.

The revetment for the water side of a dyke, a woven brush mattress anchored with rocks and rip rap

The dyke is keyed in and a core of boulder clay provided from the sea bed. This is placed by dumping from hopper barges to the water surface, and then with floating cranes having 80-foot jibs and grab buckets. Sand is dropped behind the core wall by hopper barges, and then suction dredges pile up sand at the inside of the core wall above the water line. Large rocks 1 to 2 tons each and boulder clay were used in closing the dyke of the first or northwest unit, for the tide flow increased to some 12 feet per second. The dyke crest height is made approximately 24 feet above Amsterdam normal water level, and is 6½ feet wide. An inside shoulder 13 feet above this datum is provided to carry a railway and a paved road. The average water depth on the outer side will be some 10 feet. A woven brush mattress is sunk below water and covered with loose rocks and then rip rap, carried to 11 feet above water level. The slope outside is 4:1 and inside 3:1.

Three-fourths of the 50,000 acres of the Northwest unit is served by an electric pumping plant located near Medemblik, and named the "Lely" in honor of the engineer, Cornelius Lely, who developed the plan of reclamation. A smaller diesel plant is situated at the north end of the dyke. These modern installations supersede the picturesque wind power water lifters used for centuries.

The "Lely" pumping plant was built by making a ring dyke or cofferdam, and then pumping out and excavating the site. A reinforced concrete floor was then placed on piling, and the pump case as well as inlet and outlet were constructed thereon. Three vertical-shaft, direct-connected, centrifugal pumping units are provided, having concrete casings which are grouted and asphalted inside. The pump runners are 8 1/6 feet in diameter. Normal capacity of each pump is 61,000 gallons per minute. The motors are 900 horsepower with speed adjustable from 88 to 107 r.p.m. Each pumping unit and accessories are well housed and cared for by an engineer, two assistants and a helper. The period of operation is estimated at 1,430 hours per year.

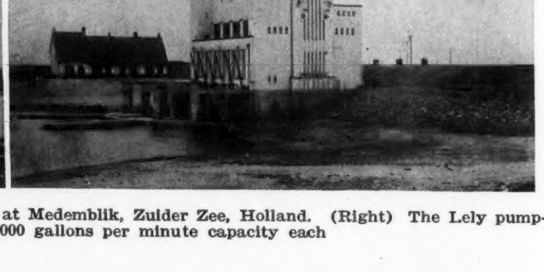


The heavy double lines from Medemblik up to Oeven indicate the recently completed dyke shutting off the Northwest "Polder" or district from the sea. The broken lines from Oeven over to Harlingen show where the 18½ miles of main dyke are to be built in the next two years. The other broken lines show where secondary dykes are to be built to make possible the drainage of other districts

At Andijk, near Medemblik, an experimental tract of 100 acres of the sea was dyked and pumped out for cropping tests which are now of two years duration. According to Dr. D. J. Hissink, the clay sea bed contains 10 to 12 per cent of powdered shell line. Green manure crops yield carbon dioxide which forms carbonic acid and brings this calcium into solution to aid removal of the sea salt residues by drainage. The soil is converted from sodium-clay to the more friable calcium-clay, and excellent crops of potatoes, beets, grain and grasses were produced the second season since reclamation. Vetch is proving to be a valuable leguminous green manuring crop for this land. At the experimental field surface ditches and mole drains are being compared with under drains.

Settlement is not to be permitted until the interior system of laterals and roads is completed. Each 50-acre strip will be served by a road and at least a small navigable ditch. Dairying, poultry, and bacon production are intensively practiced on the older reclaimed sea bed lands. In the adjacent districts fiber flax and sugar beets are also grown on former sea bed land. Baled straw was being moved to cooperative paper pulp mills on barges, or three-wheeled wagons, and the returns were reported to be $8 to $10 a ton.

This gigantic reclamation enterprise is estimated to cost approximately $210,000,000, and should recover land reckoned at $200,000,000. The reduced maintenance cost from shortened sea dyke line it is estimated would capitalize at $40,000,000. Transportation will be improved; fresh water will be made available for stock and canals in dry periods; and Holland's tillable area increased approximatey 10 per cent when this development is completed.

(Left) Newly drained sea bed and part of the northwest unit dyke at Medemblik, Zuider Zee, Holland. (Right) The Lely pumping plant which contains two pumps of 61,000 gallons per minute capacity each

The Depreciation, Cost and Use of Farm Machinery[1]

By J. F. Harriot[2]

THE increasing use of farm machinery and especially of farm power machinery is one of the outstanding features of the developments now taking place in agriculture. The substitution of machine power for both man and horse power is in evidence on nearly every farm. Not only does such substitution result in an appreciable conservation of time and energy of both men and horses, but often it lowers power costs, improves the quality of work done, increases the output per farm worker, and enables the farmer to operate a larger acreage.

In many branches of farming increases in labor efficiency have been sensational, and farm machinery accounts for much of the change. No matter how changes in efficiency are measured, the same general trend is apparent.

In 1850 the average number of work units per worker engaged in agriculture in the United States was 108. In 1890 the average was 173 per worker, and in 1920 it was 231. Each worker, in 1920, was getting more than twice as much done in a year as each worker did in 1850. In 1850 there were 22.8 acres of improved farm land per agricultural worker in the United States. In 1920 there were 46.1 acres per worker.

Apparently we are not slowing down to any noticeable extent, in this march of progress of efficiency in agriculture. Fifteen years ago, in New York, it took 100 hours of man labor to grow and harvest an acre of potatoes. Now, with higher yields and more operations, it takes 80 hours per acre. In the past 15 years, the man labor requirements for growing and harvesting an acre of alfalfa have been reduced 50 per cent; for small grains there has been a 25 per cent reduction in the labor requirement; for corn for the silo, 12 per cent; and for cabbage, 10 per cent. Further improvements in hay machinery, combines, corn binders and cabbage setters will further reduce the time requirements on these crops.

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at Rochester, New York, October, 1930.

[2]Department of farm management and agricultural economics, Cornell University.

While agricultural engineers and manufacturers of agricultural machinery deserve a good deal of credit for their part in this progress, we should not sing their praises too loudly, or they might forget how long it has taken them to get a lubricating system for farm machinery that really lubricates; or to put a steering device on the front wheels of manure spreaders, so that it is not so easy to break the reach; or that it has taken 45 years to get a workable combine east of the Mississippi River.

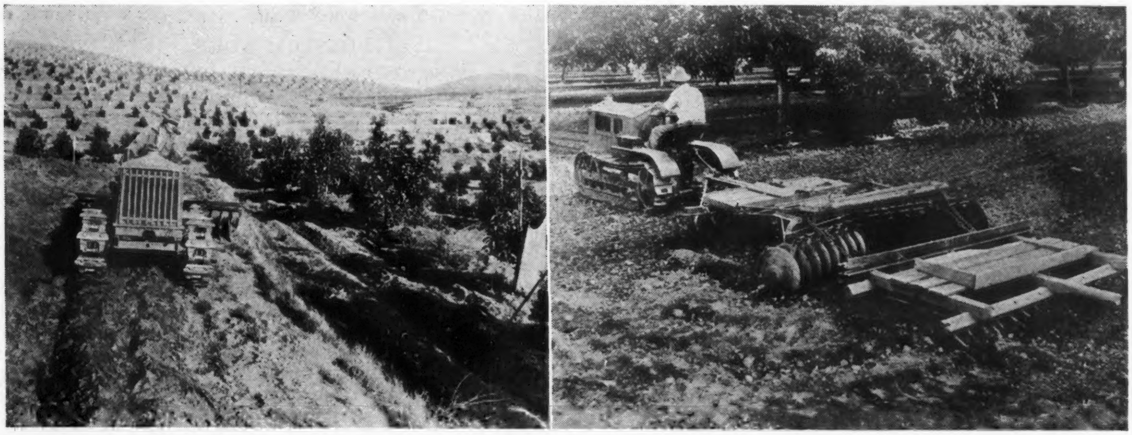
We need more and better farm machinery. This machinery must be durable, serviceable and economical to operate. The agricultural engineer and the agricultural economist must do more of their work together, or at least be familiar with the point of view and problems of the other fellow. Engineers and economists have some real problems ahead of them in the field of farm machinery.

The agricultural engineer must precede the economist to some extent in this field. The engineer will probably render his best service if he looks to the problems of designing tools that farmers need, seeing to it that these tools are well constructed, are of adequate size and power, and that they do the job well.

Engineers and manufacturers should not disregard the suggestions that farmers make. Rather they should go to them frequently, study their machinery needs and problems under farm conditions, try to correct the defects on the machines now in use, and so design new machines that the experimental bills which farmers pay in trying them out are not too large.

The agricultural economist's part in this farm machinery problem is to help the farmer in getting satisfactory answers to such questions as these:

1. What tools should I own or rent, and what machine work should I hire?
2. What is the best size of machine for my conditions?
3. Should I have one or more of any particular kind of machine?



This Cletrac tractor (left) is shown here operating in a citrus nursery stock orchard near Whittier, California. The other tractor (right) is at work in a walnut grove in the same state. In California the most outstanding development in the use of mechanical power and modern farm machinery has been made of any place in the world. Equipment of the sort shown in these pictures has been the important factor in such development

4. What are the comparative costs of operations done with different tools, or in different ways, or with different sizes of power units?
5. How will this machine affect the organization and management of my farm?

Every new piece of farm machinery is an experiment and must be given a number of trials under farm conditions, to give it the financial test. No machine is economically justifiable unless it can be demonstrated that such a machine reduces costs, or increases returns enough to pay for itself. The saving of an irksome or tedious job by using a machine is of no particular advantage, especially if farm costs are increased, unless the time saved can be used to better advantage. Many farm machines have been sold to farmers before these farmers have had time to analyze their situation and think through the probable effects of the new machinery on relative costs and returns.

ECONOMICS OF FARM MACHINERY

But to get down to the agricultural economist's part in farm machinery problems, let us consider briefly a few specific studies as illustrative of the kind of work they are doing and their methods of presenting results.

In New York state two rather comprehensive studies have been made of the costs of operating farm tractors. The first of these was made in 1920 by Prof. Myers, and the second in 1927 by Dr. Gilbert. In addition to these two studies, we have been collecting data each year on tractor costs on a number of farms (62 in 1929), where complete accounts are being kept.

Of the 190 tractors on the 175 farms included in this study, 154, or 81 per cent, were either Fordsons, or 10-20 McCormick-Deering tractors. In the remaining 19 per cent, 12 different makes or sizes were represented, but no one of these 12 makes or sizes represented as much as 4 per cent of the total number. If a tabulation of tractors on these same farms were made today, the relative importance of these different makes would probably be greatly changed. The "Farmall," "DoAll" and other makes of that type now seem to be increasing in popularity with New York farmers.

The average cost per tractor (exclusive of an operator) on 175 farms in 1926 was $269.

Direct cash outlays for fuel, oil, grease and repairs accounted for 48 per cent, and the overhead costs for depreciation, interest, housing, and farm labor for repair work accounted for 52 per cent of the cost. The charge for depreciation was larger than the cost of fuel. Depreciation and interest together made up a larger proportion of the costs than did fuel, oil and grease.

Expressing these costs on a per-hour-of-use basis, the depreciation cost was 31 cents an hour; fuel, 28 cents; interest, 8 cents; oil, 8 cents; cash repairs, 5 cents; and farm labor for repairs and care, 4 cents. The total cost per hour (based on 313 hours) was 86 cents, exclusive of driver, or $1.16, if 30 cents is allowed for one hour's labor of the operator.

Depreciation on new machinery is high and repairs usually low. Depreciation decreases and repairs increase as a machine gets older. Depreciation figures reported in this study are based on the averages of the farmers' estimates of the values of their tractors. The annual cost of depreciation and repairs for the tractors bought in 1926 was $167, while these 2 costs totaled only $40 for the tractors that were 9 years old.

The estimated life of 181 tractors was 8.5 years. For tractors that were used less than 200 hours in the year, the estimated life was 9.3 years, while for tractors used more than 600 hours per year, the estimated life was 7.4 years.

The greater the annual use, the larger the total depreciation, but the lower the cost per hour for depreciation. Depreciation per hour of use was more than three times as great for tractors used less than 200 hours in the season, than for tractors used more than 600 hours. To put it in another way, more than trebling the hours of use increased depreciation only 80 per cent.

The depreciation on three-plow tractors was nearly double that of two-plow tractors, but very few three-plow tractors were included in this study.

The average fuel consumption for all two-plow tractors was 16.9 gallons per 10-hour day of use, and for three-plow tractors was 20.6 gallons per 10 hours.

Nineteen Fordson tractors used gasoline only, and 16 Fordsons used kerosene only, so that a comparison of costs with different kinds of fuel was possible. The fuel cost per hour of use was just about the same for gasoline and kerosene, but the farmers who used kerosene only estimated a much higher depreciation charge, yet had a lower repair bill. The difference in the cost per hour of the tractors using these two fuels was about 6½ cents in favor of gasoline.

Fuel consumption by two-plow tractors for different operations, average for all work done, shows that tractors using kerosene only used 18 gallons per 10-hour day, and tractors using gasoline only used 15½ gallons per 10-hour day. Drawbar work required from 2 to 3 gallons more of fuel per 10-hour day than belt work.

Differences in fuel costs are insignificant, but if different fuels are responsible for differences in depreciation and repair bills, then this matter of kind of fuel is important.

Repair bills are somewhat higher when the hired man drives the tractor. Our comparison may not be fair, since the tractors driven by hired men were nearly a year older than the tractors driven by owners, and also were used 21 hours less during the season. But the average cost per hour for repair work on tractors driven by hired men was a little better than 7 cents, while on tractors driven by owners it was a little less than 5 cents.

Hours of use affected total cost per hour just as it affected the depreciation per hour. The cost per hour of use for tractors used less than 200 hours was $1.37, while the cost per hour for tractors used 600 hours or more in the year, was only 64 cents, the average for all tractors being 86 cents. This is exclusive of any charge for the operator's time.

As was previously stated drawbar work requires somewhat more fuel than belt work. Drawbar work usually requires the constant attention of the tractor operator, whereas for belt work the operator of the tractor can often do other work while the tractor is running. For these reasons we find that the total cost per hour (including the charge for the operator's time) for drawbar work was $1.25, and for belt work about 86 cents.

CUSTOM WORK

The amount of custom work done by tractors included in this study indicates that most tractors can do more work than most farms provide. Custom work is one means of justifying tractors on small farms. One hundred six of the 175 tractor owners did some custom work in 1926. The amount of custom work done varies with different regions. In the fruit region studied, very few tractor owners did any custom work, whereas in the general farming region (Cayuga County) more than three-fifths of all tractor owners did some custom work. Since the rate of pay received for custom work exceeded the costs of operating tractors, the tractor owners who did some custom work not only received a fair rate of pay for their time, but also lowered the overhead charges for tractor use on their own farm. The average rate charged for disking was $1.57 an acre, or $3.14 an hour. Sawing wood was done at an average of $1.50 an hour.

About nine-tenths of the plowing and practically all of the fitting were done by tractors. Many other jobs were done with tractors, but the greatest advantage in using tractors results when they do the heavy drawbar

We need more and better farm machinery. It must be durable, serviceable and economical to operate. The agricultural engineer and the agricultural economist must do more of their work together. They have some real problems ahead of them in the field of farm machinery

work. Horses are often more economical, even though one has a tractor, for the lighter work done at a fairly rapid rate.

In disking the tractor was equivalent to 12.2 horses, but for such jobs as spraying, potato digging, and loading hay, the horse equivalent of the tractor was less than 2. With two-row diggers and eight-row sprayers, the tractor may have a much higher horse equivalent.

Tractor owners estimated that tractors displaced 1.8 horses and 3.6 months of hired labor per farm.

Whether or not to buy a tractor, or to buy a second-hand tractor is strictly an individual business proposition. The prospective tractor owner must consider at least two big questions, "Will it pay?" and "Will it pay better to invest limited capital in a tractor or in something else?"

Before someone reminds me that these figures are 4 years old, and may be out of date, let me hasten to present the figures from 28 tractor accounts for 1929, along with a 5-year average (1925-29) from 111 tractor accounts. But before doing so, let me repeat that the cost figures for tractors already given were for just tractors (with or without the operator) and did not include costs of any auxiliary equipment used with the tractors.

The cost figures I will now give are for tractors together with the tools used with them. In making comparisons, we should allow approximately 15 cents an hour for the use of tractor tools for the 5-year average (1925-29).

With 329 hours of use, the average cost per tractor on 28 farms in 1929 was $358, or $1.09 per hour. As nearly as I can figure, the cost of the tools per hour of use was 20 cents, which means that the tractor costs were 89 cents an hour. This cost is 3 cents an hour higher than Gilbert's average for 175 farms in 1926, and the tractors on the cost account farms in 1929 were used 16 hours more than those in the survey. The slightly higher costs may be due in part to a more exact cost accounting process, or may be due in part to the type of work for which the tractors were used, or some of the higher cost may be due to the farmer's experiments with the newer types of tractors for cultivating, potato planting and other such jobs. Tractor costs have not changed greatly in the last five years.

Engineers are not interested in the costs of keeping horses, but farmers frequently ask about comparative costs of horses and tractors. Let me take just one minute to give you a few figures on this point. The cost of keeping 119 horses on 34 farms in 1929 was $181 per horse. These horses worked an average of 763 hours at a cost of 21.9 cents per hour. The cost of keeping two horses was $362, or $4 more than the total cost of a tractor with its auxiliary equipment. This comparison leaves out the cost of the equipment needed with the horses. It looks as though horses must further give way to tractors and power equipment.

Cost accounts on 35 farms for the last year show the average value of all farm equipment to be $2234 per farm. In our cost accounting work on these farms, we handle tractors, trucks, hay-presses, combines, light plants, and other such equipment in special equipment accounts, so that if we ever get enough accounts with any one large piece of equipment we can make a detailed study of that equipment. I have already indicated that on 28 of these farms, the cost per tractor for tractors and auxiliary tools was $358. The average cost of operating 24 motor trucks was $410. Farm light plants on 8 farms cost, on the average, $209 for the year. The cost for the year for one combine on which we had figures was $624, of which $500 was the depreciation estimated by the farmer. This $624 cost does not include the cost of the tractor used with it, nor does it include any charge for the operator of the combine. It is the annual cost of the combine itself. A total of 154 acres of grain were combined, the average combine cost per acre being $4.05.

Some of you may be interested to know that within the next month, one of our graduate students at the New York State College of Agriculture at Cornell University, will begin a study of the costs of operating combines on New York farms. If he has good luck and gets the usual hearty cooperation from the farmers, the results should be available next spring.

In 1927, R. F. Bucknam made a study of the cost and uses of farm lighting plants on 605 New York farms. He found 24 standard makes of plants and 19 plants that were assembled by farmers from engines, generators and batteries of various makes. The oldest plant had been in use for 17 years. The most common size of plant was 850 watts, and 50 per cent of all plants were from 800 to 1000-watt size.

The average cash costs per farm for the year was $44 05. Battery replacements and depreciation averaged $51.20 per farm; interest was $14.25, and farm labor for care and repair was $10.62, making the total cost of operation for the year, $120.12. This cost is only 60 per cent of the average cost found on 8 farms last year.

Gilbert also studied costs of operating farm motor trucks in 1926. Results of that study are reported in Bul-

letin 507 of the Cornell University Agricultural Experiment Station, published in June, 1930.

In his summary, Gilbert has this to say about farm motor trucks: "Every farmer who is considering the purchase of a truck should consider carefully these points:

"1. The present and probable future amount of hauling to be done.

"2. The possibilities of hiring other truck owners to do this hauling at a lower cost.

"3. The amount and value of man and horse labor that could be saved by using a truck.

"4. "The relative costs of hauling with trucks and with horses.

"5. The present and probable future conditions of roads over which the hauling will be done.

"6. The possibilities of obtaining a wider choice of markets with prices which will justify the extra costs of hauling to those markets.

"7. The possibilities of adding to the farm income by adding cash enterprises, the products of which could be marketed advantageously with the added facilities of hauling."

The investment in horse-drawn tools, hand tools, and some miscellaneous small equipment on cost account farms in 1929 was $992 per farm. (This was included in the $2234 investment previously mentioned.) The annual cost of maintaining this equipment was $410, or 41 per cent of its value. Depreciation accounted for 34 per cent of the cost; cash repairs, 15 per cent; and interest, 6 per cent, the sum of these three items being 55 per cent of the total cost.

Many tools are used only a few days each year so that the cost per day or hours of use is high. Last week my students in farm accounts assembled some data from their home farms which gives a good picture of how much certain machines are used. Table XVI shows this data. Tractors were used on 53 days. (Gilbert's study indicated 313 hours of use; cost accounts for 1929 indicated 329 hours of use.) Spreaders were used on 27 days; gang plows, 18 days, and so on down the list, until we find cabbage setters being used an average of only 5 days a year.

Most of the available figures on the life of farm machinery are based on estimates by farmers of the expected life, rather than on the actual life of the machines. Wallace (of Iowa) is the only investigator I know of who has published any data on actual life of farm machinery. One difficulty in this problem is the trading in of machines before they are worn out.

The days of use and the care given largely determine how long any farm machine will last. In New York, grain drills, corn binders and grain binders are used only a few days in the year, and these tools usually get pretty good care. As a result, their useful life is much greater than such tools as gang plows, side rakes, diggers and other tools which get harder use and less care.

One-fifth of all grain drills, one-fifth of all corn binders, and one-seventh of all grain binders covered by this student survey were over 20 years old. Seven-tenths of all the gang plows and side rakes, and three-fifths of all the tractors, manure spreaders and hay loaders on these farms were less than 5 years old.

Land Utilization[1]

HOW to make a better use of our land resources is a pressing problem. It would demand attention even if there were no crisis of overproduction. It is not simply a question of finding new uses for farm lands whose products can not now be profitably sold, but of allocating various types of land to the most advantageous ends.

In the United States we have a domain of nearly 2,000,000,000 acres, of which about 400,000,000 acres are classed as employed for cultivation. But if needed we could use nearly a billion acres for crop production. This is about half the total area of the Nation. In a general way our crops are grown in the areas to which they are best adapted; but a much better adjustment than that brought about by trial and error is possible. Heretofore much land has been occupied in ignorance of better lands elsewhere, as well as of progress in agricultural technic, and is now unprofitable. Much land has been put into crops that should have been left in grass or forest. Large areas have been settled under conditions that invited failure. The time has come to correct some of the mistakes of the past and to take precautions against similar mistakes in the future.

A profitable agriculture, however, can not be brought about merely by correction of past errors. It is becoming necessary to reshape the very foundations of the agricultural industry. Nothing less will accommodate it to the pressure of the powerful economic forces affecting supply and demand conditions. On the demand side, for instance, the displacement of work animals by power-driven machinery is removing the need for many million tons of corn, oats, and hay. Changes in diet are lessening the demand for certain products and increasing the demand for others.

On the production side technical progress is bringing extensive semiarid areas into cultivation not only in the United States but also in Russia, Canada, Australia, Argentina, and elsewhere. Labor-saving machinery is promoting the cultivation of low-yield areas that formerly could not be profitably cultivated. American agriculture, always more economical of labor than of land, is pushing this principle to a new high level. Yet it has, of course, no monopoly on efficient farm technic.

In our Federal reclamation policy it seems highly desirable to weigh the advantages of local or regional development against the disadvantages of promoting excessive agricultural expansion. Many proposed reclamation projects involve nonagricultural considerations, such as flood control and the development of water power. Such projects obviously can not be judged exclusively from an agricultural standpoint. Moreover, the number and scope of such projects seems likely to increase. The Nation is working gradually toward comprehensive flood control in place of piecemeal local drainage and levee construction. This broad policy should be more efficient and economical than the one it replaces. There are, however, many reclamation projects under discussion that should be considered primarily, if not exclusively, from the standpoint of agricultural welfare. It is a serious question whether in view of the existing overproduction in agriculture it is advisable to promote agricultural expansion through irrigation and drainage. The Federal reclamation policy involves a direct subsidy to agricultural expansion in the form of interest free loans. This subsidy policy seems inconsistent with the efforts now being made by the Federal Government to restrict agricultural production. Studies of our land requirements which take into consideration the available land areas, the probable growth of population, the trend in consumption, technical progress in agriculture, and foreign-trade prospects indicate that the present need is not agricultural expansion but contraction.

[1]From the Report of the Secretary of Agriculture, 1930.

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An Agricultural Engineering Extension Building Demonstration

By A. D. Edgar[1]

AGRICULTURAL engineering building demonstrations were started in Michigan by O. E. Robey in 1914, with the building of two-chamber septic tanks. Since then other buildings demonstrations have been tried, some of which have been carried on from year to year, and others dropped after a trial. The following projects are now being carried on in the agricultural engineering extension program: (1) A septic tank building demonstration in cooperation with the Portland Cement Association; (2) a bull pen and breeding chute building demonstration in cooperation with the dairy department and (3) brooder house and laying house building demonstrations, both in cooperation with the poultry department and insulation companies.

That poultry house building demonstrations have had an important place in the farm building work of the state is shown from attendance at meetings and questionnaires sent to county agents and to farmers where demonstration houses had been built.

Where questionnaires have been sent the farmers after the demonstrations they have shown that more people have visited the houses after than during demonstrations, and that there are about eight houses built as a result of each demonstration house. George Amundson, head of agricultural engineering extension work at Michigan State College, who has been closely connected with the building work since its start in 1926, estimates that during the years of 1926 to 1930, $5,000,000 have been spent for materials for laying houses and brooder houses, in Michigan, and, since demonstration houses have been constructed in most of the counties, most of the building has been influenced and benefitted by the building demonstrations.

The advantages of any extension building program may be well illustrated by the Michigan laying house building demonstration. A permanent model is placed in a community, where it may be inspected by neighboring farmers, and when placed in areas where different conditions exist, the adaptability of the building to all sections of the state may be studied. This gives the agricultural engineering department a project similiar to the pure bred sire project of an animal husbandry department, or the certified seed work of a crops department. That is, we leave a model in a county where it may be seen, and also to have it in an area from which we may learn its adaptability.

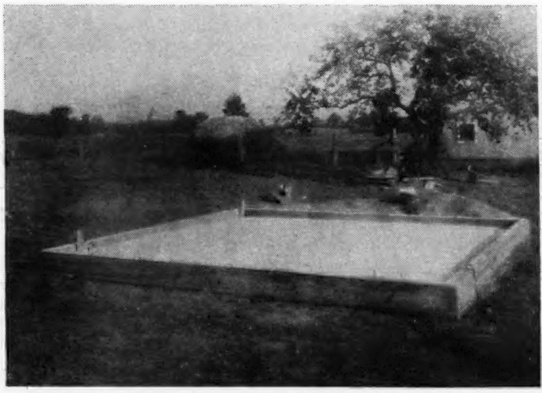
A 20x20-foot laying house completed in two days by four trained men and local untrained help creates something of a sensation, and shows the value of careful planning of buildings, organized work, trained men and power equipment—all factors in agricultural engineering.

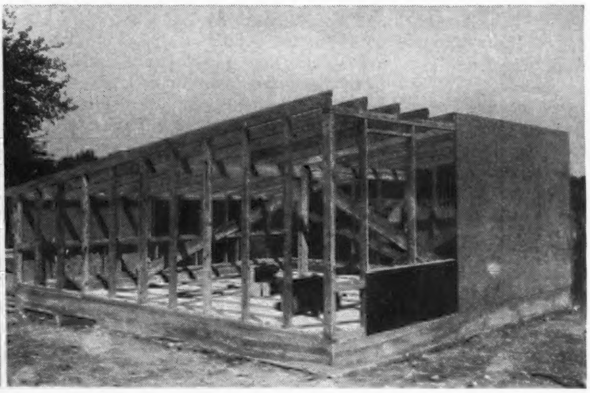
That the program works out has been proven. The models are visited and widely copied. A drive through any section of the state will show how completely the shed-roof laying house has been displacing half monitor and sunlit houses formerly so common.

People attending demonstrations are surprised to see the house actually completed. They comment on the fact that materials work out with so little waste, and that the four men on the crew work on different parts of the building, each using unskilled local help to advantage. The demonstration gives the farmers a new conception of college men. At one demonstration this year one farmer said, "I expected to find a bunch of white-collared men standing around and telling us what to do, but those fellows started right in, and I had to beg for something to do." The power saw monopolizes most of the "show," however, for there is always a crowd around speculating on how they could rig one up to do their sawing. On the job, the saw probably takes the place of four men.

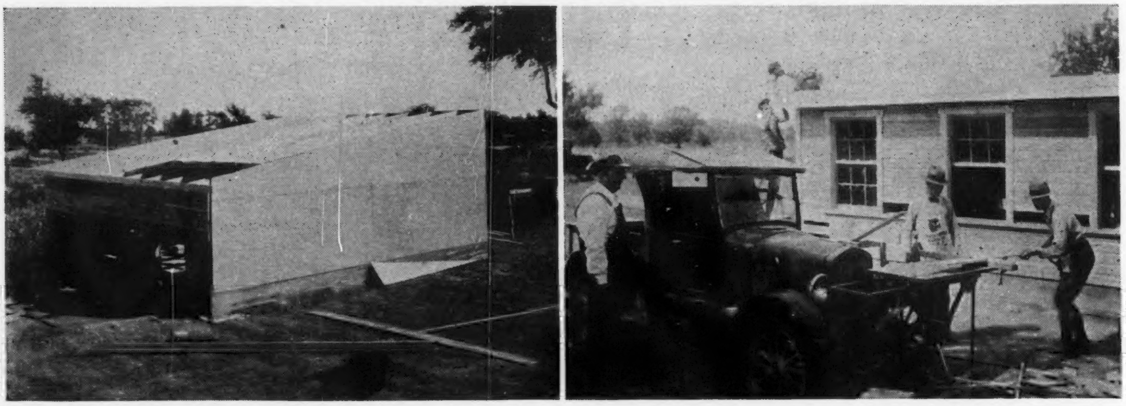
A need for warmer houses led to the substitution of board form insulation instead of shiplap for sheathing. Experience gained in using insulation soon led to the practice of putting it on the outside of studding and above rafters, instead of ceiling inside of studding and below rafters, as is the common practice. Since chickens will peck and destroy exposed insulation, protection in the form of tar paper or pearl fly screen is applied around the lower 18 inches of the wall and near perches. A few changes have been made in the bill of material to permit the use of commercial sizes of lumber without waste. The present bill of material and blueprints available to farmers wishing to build the shed type house are fully detailed and designed to give added help to the farmer in cutting ma-

[1]Extension agricultural engineer, Michigan State College, Mem. A.S.A.E.





(Left) Foundation and concrete floor ready for the building of a demonstration shed type laying house. (Right) The house with framework up and part of the tar paper and insulation on



(Left) Another view of a house with most of the insulation and part of the siding on. (Right) The portable power saw, front of a nearly completed house and part of the demonstration crew. The man wearing the carpenter's apron and watching the sawing operation is the author, Mr. Edgar

terial. The cost of material for the 20x20-foot laying house runs between $200 and $250, and the labor without power saw can be done by four men in a week. It is one of the most economical houses in use in the state.

Requests for the laying house building demonstrations are received at the December county agents conference. The meetings are scheduled by the extension department for from 2 to 3 two-day demonstrations per week, during September, October and part of November of the following year. The scheduling ahead is necessary to prevent conflicts with other extension work.

The county agent confers with the cooperator wanting a house, instructs him in locating the building, and gives him blueprints and a bill of material. The county agent also advertises the meeting both by letter and newspaper. He has to keep in touch with the farmer to be sure the foundation is in readiness for the demonstration. On the day of the demonstration the building crew gets out bright and early and takes charge of the job. The crew consists of an extension agricultural engineer, a power saw operator, and an experienced carpenter, all agricultural engineering extension workers, and a specialist in poultry extension work. The agricultural engineers also furnish a power saw mounted on a Model T Ford, and all tools necessary for the job. The extension agricultural engineer is in charge of construction, and each member of the crew has his part of the job to do. Quite a bit of the job is getting the farmers to pitch in and get some experience on the building. A meeting which is advertised for the afternoon of the second day is held in the finished house. The county agent calls the meeting and introduces the speakers. The poultry specialist talks on poultry housing requirements, equipment and other poultry questions. The extension agricultural engineer points out how the house has been constructed to meet the requirements of the poultry department, explains the details of construction, taking up concrete, lumber, insulation and roofing. Or, where a concrete, or an insulation specialist is on the job, he is asked to discuss his specialty. Throughout the meeting features of the house are pointed out and discussed.

CONCLUSIONS

1. The laying house building demonstration is one of the best demonstrations in the agricultural engineering program from the standpoint of concrete results obtained for the money and effort expended.
2. It is a favorable type of demonstration to get the buildings work of an agricultural engineering department before the farmers of the state.
3. The ten-week building schedule is hard work for the crew, but because it is so easy to see the results of the work, all agree that it is well worth while.
4. The laying house design was developed through the use of demonstrations, with a minimum of mistakes expensive to the farmer.
5. The demonstration is an example of agricultural engineering. Houses up to 20x60-foot sizes have been constructed in the two-day building period, with the whole building enclosed, and at least one sample of each detail finished. Other buildings have been cut out on the drive floor of a barn, during rainy weather, and put up between showers. All houses of the 1930 program were completed on schedule.
6. We realize that the shed-type laying house is not the last word in poultry houses. It may be advisable either to add heat or more insulation for Michigan weather. But we do feel that the shed-type house is one of the best types so far advanced. Straw loft houses are being recommended for remodeling jobs, but we have not seen fit to use them as demonstration houses.
7. The following improvements are to be desired: (a) have county agents arrange with cooperators farther in advance of meetings; (b) work out a plan that will enable the farmer to lay out and build better foundation walls and floors, and to have material on hand in plenty of time; (c) encourage the use of old material when labor and time are plentiful, but discourage its use at demonstrations; (d) eliminate cancellation of agreement to build by the cooperator at the last moment (It prevents someone else in the community getting a house); (e) have more farmers help with the house as a further aid in showing how the house is built.

Only four out of eighteen foundations in the lower peninsula this year were really high class jobs. It was hoped that next year a double demonstration could be scheduled, one to build the foundation in advance of the regular building demonstration. Due to lack of men and money, this will not be possible. However, a schedule for laying out the foundation and going over the method of constructing the foundation probably will be allowed next year as an improvement on the present set up. A better understanding between extension workers and county agents is being obtained, so the improvements indicated are being realized in an increasing number of counties.

A Study of Farm Roofings[1]

By M. C. Betts[2]

THE roofing problem is one of most important confronting the designer of farm buildings, and he has but little to guide him in making a decision Choice of material is often difficult not so much because of the conditions to be met, but rather because there is so little authentic information with regard to the relative merits of the various materials offered on the market.

Aside from specifications as to limitations of roof pitch I have yet to see any popular sales literature in which unsuitability under certain conditions is specifically stated. The selection of roofing material must be made with consideration of a number of factors, such as cost, durability, insulating value, fire resistance, suitability to structural conditions and appearance.

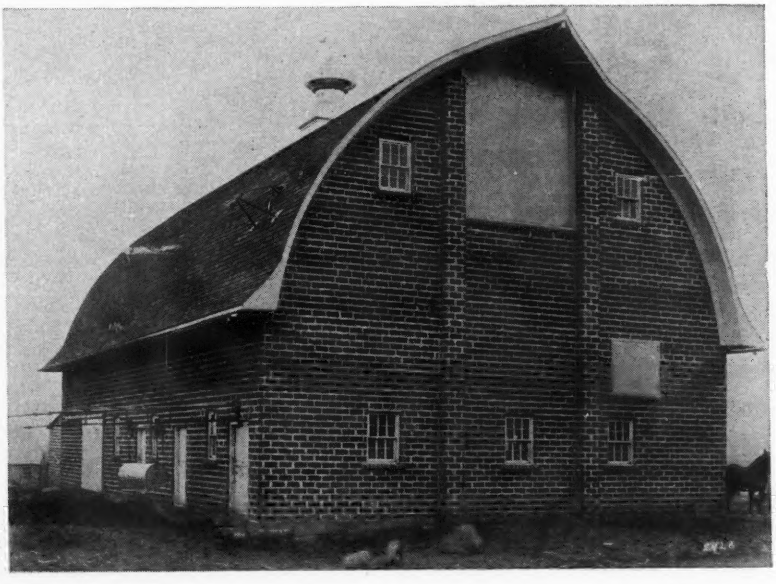
We are not particularly concerned with roofing of a strictly temporary character. There is very little need of such roofing on farms, and any material that will shed water and hang together for a few weeks or months will generally serve. The term "temporary" may be applied to one of the less durable and cheap materials placed upon a substantial structure because of lack of funds and with the intention of substituting a more suitable covering later. Usually such a roof becomes permanent to the extent of its life, the application of a better roofing being put off until necessity forces it. After all, permanency in roofing is but a relative term and is of varying degree depending upon the character and quality of the material.

Generally the greater the degree of permanency the greater the cost of the roofing and the cost, unfortunately, is an item which gives the farmer and the agricultural engineer much concern. Cost in the minds of many with limited funds means initial outlay. The annual cost is overlooked—likewise economic considerations such as the relation of roofing cost to that of temperature maintenance within the building or the damage to contents due to the development of leaks in a cheap roof. This attitude toward cost accounts for the rather widespread tendency to buy on a price basis and a corresponding tendency on the part of many manufacturers to produce and sell on a price basis. As a consequence there are on the market inferior products which to the average purchaser appears to be the equal of other similar material commanding a high price but which actually are expensive at any price. This is particularly true of the prepared roofings. Without definite knowledge of the comparative merits of the various materials available and means of determining the quality of a given material, the purchaser is often at a loss in providing a proper roof for his building.

The degree of permanency to be sought in a farm roof is a debatable question, the economics of which, so far as I am aware, have not been definitely established. Is it desirable to erect structures which will last for two or three generations in view of the fact that changing conditions render farm buildings obsolete just as they do other structures? We have many instances of farm structures built many years ago which are still in use but which do not conform to the present day conception of proper design; others have been abandoned for one reason or another and have little or no salvage value. In erecting a new house or barn should a farmer build for two or three generations expecting his family to remain on the property and to inherit his invested capital or should he build for himself alone? If the latter, should he put on a very long life roof or one that will serve him during his probable life? Will a very long life roof add to the sale value of a farm? Deane G. Carter, agricultural engineer, University of Arkansas, has found that in the territory studied in Arkansas the average dwelling house owner tenancy is about 15 years. It would be helpful if we had similar figures for the country as a whole.

At the present time very few farm structures are being roofed with materials which may be expected to last a lifetime without more or less extensive repairs. This is undoubtedly due to the high initial cost of such roofing and the questionable economy of such practice. A careful economic study of the matter should be of considerable value to the designer of farm structures.

No one material has all the qualities demanded of farm roofing. A durable roof may have no or very little insulating value as is the case with slate or asbestos shingles. The durability of a roofing material may depend upon the



"Utility must be the first consideration of a man who is trying to make a living on the farm, but a little investment in appearance pays," says Mr. Betts in the accompanying paper. And this applies to the roofing for farm buildings. In any effort to design and build an architecturally attractive as well as an utilitarian building, the design and color of the roof is an important factor

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at Rochester, N. Y., October, 1930.

[2]Architect, U. S. Department of Agriculture, Washington, D. C. Mem. A.S.A.E.

Farm roofing presents some nice problems for research investigation. There is the economic relationship between durability and first cost; the development of more durable low cost materials; the improvement in form and appearance of existing inexpensive roofings; the development of more effective protective coatings for metals subject to corrosion, the development of rust-resistant metals to be sold at a price within the farmer's reach

protection given it, as with steel products which in many localities must be frequently painted to prevent or retard corrosion.

Durability may also depend upon the method of application and workmanship. Zinc is a lasting material but provision must be made for considerable expansion and contraction. It is brittle and cannot be handled at temperatures below 40 degrees. It should be laid by experienced men. Wooden shingles of good quality are lasting and afford a degree of insulation but constitute more or less of a fire hazard depending upon their condition.

Insulating value usually is of minor importance so far as the covering material is concerned, with the possible exception of sheet steel when employed without sheathing. None of the commonly used materials are of material value as insulation. A certain amount of insulating value is added by the sheathing required under most roofing. Where any degree of thermal control is desired insulating materials must be employed in addition to the roof covering and usual sheathing.

Fire-resistance in a roof covering is of particular importance with respect to the prevention of fires due to sparks from a heating unit within the building or from a burning building perhaps some distance away. Sparks falling on roofs are responsible for 8 per cent of the total farm fire loss and about one-fifth of the farm dwelling fires. Fire-resisting qualities in a roof covering are also of value in that they retard the progress of fire originating immediately under it. Fire will soon burn through a flammable roofing thus increasing the draft and causing rapid spread of the flames. From the fire-prevention standpoint roof coverings should be of fire-resistant materials. Quoting from Farmers' Bulletin 1590, "Fire Protective Construction on the Farm," which embodies the recommendations of the Committee on Farm Fire Prevention of the National Fire Protection Association, "The roof covering of all farm buildings, with the possible exception of small detached temporary structures the contents of which are of small value, should be chosen with careful consideration of the real cost and the protective properties. The first cost is of less importance than the cost per year of service. The fire-resistive value can not always be judged by examination of samples of new roofing materials, since some roof coverings change in appearance and in fire-resistance after a short time of service. Unless reliable information can be obtained concerning the fire-resistive value of a roofing under consideration, it would be well to use some other roofing known to be fire resistive, even though the cost is somewhat greater. Fire-resistive roof coverings should be used wherever possible.

"There are a variety of roofings on the market which afford satisfactory protection and service. The life of the best fire-resistive roofings, such as tile, metal or slate, is considerably longer than that of some of the less resistive materials. Other roofings that afford satisfactory protection are asbestos shingles, heavyweight composition shingles, and prepared roofings which have been tested and proved fire resistant and durable.

"Asphalt prepared roofings should conform to the requirements of the federal government specifications, the specifications of the American Society for Testing Materials, or the Underwriters Laboratories' Class A, B or C standards. A statement should be obtained from the manufacturer to the effect that the roofing purchased conforms to one of these standards.

"The weight of asphalt prepared roofings included in Class C ranges from 40 pounds per 100 square feet, as applied, for a single thickness of smooth-surfaced roll roofing to more than 300 pounds for heavy mineral-surfaced shingles. Generally, the greater the weight, or thickness, the better the fire protection. When this class of roofing is employed, it is recommended that shingles, rather than roll roofing, be used on residences because of their greater fire resistance and better appearance. Shingle roofing should weigh not less than 200 pounds per 100 square feet of roof surface, as applied. If roll roofing, which is cheaper, must be used, granular-surfaced roll roofing preferably should weigh not less than 100 pounds, and smooth-surfaced roll roofing not less than 50 pounds per 100 square feet of roof surface as applied in single thickness.

"Wooden shingles especially when old and dry can be set afire by chimney sparks or brands from another fire, and when burning generate flying brands which may be carried considerable distances and ignite the roofs of other buildings. When wooden shingles are to be used, the best grade of edge-grain and good wordmanship should be insisted upon.

"The susceptibility of wooden shingles to ignition by flying brands is considerably decreased by dipping them in thinned lead or oxide paint of good quality before laying and applying a brush coat of unthinned paint on the exposed butts after laying. The brush coating should be renewed periodically."

ROOF PITCH

The pitch of the roof is the chief structural consideration affecting the choice of those roofing materials which fall within the price range which the average farmer can or thinks he can consider. A roof with a pitch sufficient to warrant the use of wooden shingles (about 4 inches in 12 inches) may be covered with any of the available materials except the built-up tar and gravel roofing. A flat roof or one of slight pitch (1 or 2 inches in 12 inches) necessitates a built-up covering or one of metal with water-tight joints. The construction supporting the roof of a given building would vary but little with the choice of covering materials except that clay tile may require heavier framing and that a metal roofing, such as corrugated steel, capable of self-support over a span of several feet requires less framing lumber and no sheathing. Such a roof would be used only where protection from the sun's heat is not a consideration.

In the matter of appearance choice of material may be influenced by utter lack of appreciation—there are many who are undisturbed by lack of proportion, symmetry, unpleasant color and the like; by price—there are also many who would like something better but are deterred by cost; by peculiar taste—we are apt to apply the

term peculiar to taste which is at variance with our own but there is a real difference between good and bad taste. Good taste is an educated or naturally refined sense of appropriateness and beauty—a nice perception of artistic excellence. I must confess that there is not much opportunity for the exercise of a nice perception of artistic excellence in choosing the roofing material for a farm building when the very limited choice of materials is considered. The best we can look for is pleasing color and the appearance, if not the essence, of substantiality. I never see a strip composition shingle roof but I think of the cardboard doll house designed for the pleasure of small children. An expanse of roll roofing with its widely separated horizontal joints and a few hit or miss vertical joints showing where the rolls gave out—with the melted pitch running down the slope—not to mention the waves and hollows due to expansion and the rusty nail heads decorating the eave line—is evidence to me that the builder was thinking only of costs or had no nice sense of artistic excellence.

A roof of good color—one harmonizing with the rest of the building and the background—may appear well at a distance but not at close range because of quality or workmanship.

Utility must be the first consideration of the man who is trying to make a living on the farm, but a little investment in appearance pays. Uniformity in the roofing of a group of buildings is always more pleasing than a variety of kinds and color — if the same kind on every building of a group is not feasible let us at least have the same color—if it is pleasing and in fairly sharp contrast to the body color of the buildings which also should be uniform or at least carry enough of the same color to tie them together. The matter of color treatment is a subject much too involved for discussion here, but let us at least avoid variegated or mixed color roofings. They remind one of war times when ships and guns were camouflaged to render them inconspicuous. There is no need to camouflage our farm houses unless as a measure of protection in the next war which we are told will be in the air.

Considering, briefly, the roofing materials which are generally available we find the following facts:

There is nothing to be said against copper, except that it is too expensive for the average farmer unless it can be shown that it is good economics to put on a roofing which will outlast the usefulness of the building it covers. A copper roof means also copper guttering, flashings and downspouts, as copper used in conjunction with steel sets up electrolytic action.

Zinc is not as expensive as copper. It can be laid for less than the better grades of asbestos shingles, but cannot be handled at temperatures below 40 degrees because of brittleness. It has a high coefficient of expansion and its application requires experienced labor since, if not properly laid, and sometimes in spite of it, contraction at low temperatures will open joints. Its low melting point may be a detriment at times.

Galvanized steel is comparatively cheap and easily applied. In the form of corrugated sheets it is entirely a utilitarian product (reminding one, in appearance, of oversized washboards. In the form of flat sheets with widely spaced corrugations or V crimps it is of much more pleasing appearance, or can be made so if wisely handled. The natural color of this material is not pleasing and for that reason alone it should be painted. Except in dry climates it is subject to more or less rapid corrosion and must be painted frequently to preserve it. Lack of protective paint is the most outstanding feature of the great majority of our farm buildings. The number of ugly, rust-encrusted roofs and walls to be seen in a day's travel in many parts of the country, belies the prosperity of which we are so proud and as a national affliction is second only to the billboard. The maintenance cost of a roof of this material places it in the expensive class. It has no insulating value. It has one pronounced virtue, from a roofing standpoint, in that it affords excellent protection from fire due to sparks or brands. As placed on the market it varies considerably with respect to the thickness of the zinc coating a point not readily recognized by the average purchaser. Steel containing a small percentage of copper or other rust-resistant metal is offered on the market at a higher price. Its life is somewhat longer but painting is still necessary Light weight material is often foisted upon the purchaser by unscrupulous dealers in order to meet a price.

Roofing terneplate, or tin roofing, as it is commonly known, is in the same category as galvanized steel, only more so as the lead and tin alloy covering does not protect the soft steel base so well as zinc.

NON-METALLIC ROOFINGS

Clay tile and slate of good quality are quite durable and when of good color and properly laid make a very satisfactory roof, but, unfortunately, the cost of either is such that very few farmers could consider roofing a building of any size with these materials unless, by reason of proximity to a production plant, they can obtain favorable prices.

Slate roofs may be found on old farm buildings in certain sections of the country but I do not recall seeing a modern farm structure with such a roof. Slate of poor quality is easily broken if walked upon. Snow and ice have broken and brought down many a slate. Any slate roof is only as good as the nails holding it. Copper nails should be used.

With asbestos cement shingles we are approaching the field of choice for the average farmer. The price range is still high but this material is used to a considerable extent on farm buildings. When of good quality it is apparently durable, but it has been on the market too short a time to permit of definite data on this score. There is variation in the quality of this material, the product of some manufacturers being of greater strength and of better appearance than that of others. The heavier shingles of good grade properly laid make a serviceable roof affording good protection from exposure fires. The cost of maintenance is low.

Unfortunately the manufacturers have placed on the market shingles 16 or 18 inches square designed to be laid diagonally with a 2-inch lap. Because this method, known as the French method, requires less material than the American, in which the shingles are laid in horizontal courses like slate, a great many buildings have been covered in this way. The large units are often out of scale on a small building and the diagonal lines give a restless, unfinished aspect to the roof. Asbestos shingles should consist only of rectangular shape and should be laid only in horizontal courses.

Again, unfortunately, this material is to be had in but very few colors and they, for the most part, are weak

The best rating given by the Underwriters' Laboratories, Class A, "includes roof coverings which are not flammable and do not carry or communicate fire; which afford a very high degree of heat insulation to the roof deck; which possess no flying-brand hazard; which do not slip from position when exposed to high temperature, and which are durable and do not require frequent repairs"

giving a washed-out effect to the roof. Fairly good red may be had as well as brown and green but the green fades in time to a sickly hue. By using shingles of various colors attempts have been made to obtain a distinctive effect known as blending. This to me is not pleasing because the colors are in solid units with sharp lines of demarcation, the result being not a blending of colors but a harsh spotted, restless effect. The blending of colors should be in the individual shingles and never very marked so that the roof as a whole would be of one dominating color with light and dark shadings and tints sufficient to give it life. This, to an extent at least, is done with tile, but I doubt if it is feasible in cement shingles. The natural gray of the cement asbestos mixture (very little asbestos by the way) presents a glaring surface and gives the effect of light weight as does any very light color placed above a darker one. A roof of a color darker than that of the body of the building has the appearance of weight and a tendency to stay put.

The wooden shingle, which has served us for generations and is still going strong, may or may not be a good roofing material depending upon its quality. It is comparatively cheap, is easily laid and repaired, and, if of the right kind of wood or treated with preservatives should last a good many years. The white pine shingle, which had a very long life, is a thing of the past because of the scarcity of this wood. It is generally conceded that edged-grain red cedar, cypress and redwood of good grade make the best shingles even without preservative treatment. They do not warp or check to any extent with exposure to the weather. Pine shingles, untreated, are generally short lived, but if treated with creosote (open tank method) they may prove as durable as redwood and cedar.

Apparently the different species of pine behave differently. In an experiment carried on at the Pennsylvania State College it was found that after 20 years of exposure on a barn roof there was no appreciable difference in the lasting qualities of Western red cedar, redwood, chestnut (no longer available) untreated and creosoted pitch pine, loblolly pine and chestnut. The creosoted pitch pine shingles were warped and twisted excessively while the loblolly pine laid flat with as little checking as either the red cedar or redwood.

I have been told that in certain climates like that of Arizona cedar shingles warp badly—that they are expected to do so. I have not been able to verify the statement. If it be true it would be interesting to know the reason. If very thin shingles are used they might warp some even though dry. Shingles shipped in from a more or less humid region may be of such high moisture content when laid that they warp when exposed to the hot sun.

The wooden shingle roof, if the shingles are not too thin, has the appearance of substance; if untreated it acquires, after short exposure, a pleasing color with enough play of light and shade to prevent monotony. It is capable of effective color treatment with preservative stain or paint.

FIRE RESISTANCE OF WOOD SHINGLES

To the fire-protectionist the wooden shingle is a flaming red rag. Undoubtedly old dry shingles especially when warped and split are a serious fire hazard. Sparks or brands lodging on such a roof are fanned quickly into flame. Tests by the Bureau of Standards (not published) show wooden shingle roofs to be far more susceptible to rapid ignition by falling brands than the poorer grades of composition shingles. According to the same authority the susceptibility of wooden shingles to ignition by flying brands is considerably decreased by dipping them in thinned lead or oxide paint of good quality before laying and applying a brush coat of unthinned paint on the exposed butts after laying with periodical renewing of the brush coat.

The U.S.D.A. Forest Products Laboratory has been working on a fire-proofing treatment of wood which it is hoped will render shingles sufficiently fire resistant to warrant their more general use as roofing.

Composition shingles of good quality and weight should give satisfactory service for a number of years so far as protection from weather is concerned and at a fairly low cost. But there are on the market light low-grade shingles, apparently made of inferior materials. They dry out and curl or flap in the wind, allow rain and snow to drive under them. Such shingles are dear at any price.

Apparently there is no way for the purchaser to judge of the quality of a composition shingle except as to weight and rigidity. He can, however, insist upon shingles made in accordance with the U. S. Government Master Specifications No. 296 for prepared asphalt slate-surfaced shingles and roofing. The recommended weight of prepared roofings has already been given in a quotation from Farmers' Bulletin 1590, "Fire Protective Construction on the Farm." Anyone contemplating the purchase of such roofing and unable to judge of quality would do well to base his choice upon the experience of neighbors.

The principal objection to prepared shingles is the uncertainty of life, the monotonous regularity of units and the cardboard like appearance.

What has been said regarding composition shingles applies equally to roll roofing with the added thought that, although there is on the market some quite durable material of this kind, it has no place as roofing on the major farm structures because of its appearance. Some of the cheaper grades are readily torn and even blown off the roof by comparatively moderate winds.

FLAT ROOFS

It has often occurred to me that more of our farm buildings might be covered with flat roofs—wooden decks covered with built-up tar or asphalt and gravel. They would simplify construction in many cases. A little insulation under the covering would compensate for the air space under a peaked or shed roof. The one story cow barn attached to a feeding shed is one possibility. Such roofs having five layers of felt, are not difficult to lay, are easily repaired and should last for from 15 to 20 years or longer. According to the U. S. Bureau of Standards (Circular 70, "Materials for the Household") this type of roofing, from the standpoint of fire risk, deserves more consideration than is usually given it. This fact is best illustrated by the ratings given such roofing by the Underwriters' Laboratories. When properly laid, the better roofings of this kind have been given ratings in Class A, the best rating given by the Underwriters' Laboratories. This Class A "includes roof coverings which are not flammable and do not carry or communicate fire; which afford a very high degree of heat insulation to the roof deck; which possess no flying-brand hazard; which do not slip from position when exposed to high temperature, and which are durable and do not require frequent repairs."

Federal government master specifications for the construction of various types of such roofing are available. They cover roofs having three, four and five layers of felt laid in tar or asphalt on wood and concrete decks. An alphabetical index and numerical list of the government specifications covering a wide range of materials may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents. The specifications are sold at 5 or 10 cents each.

I haven't told you much, if anything, that you did not know, but I think I have made clear that farm roofing presents some nice problems for research investigation. There is the economic relationship between durability and first cost; the development of more durable low cost materials; the improvement in form and appearance of existing inexpensive roofings; the development of more effective protective coatings for metals subject to corrosion; the development of rust-resistant metals to be sold at a price within the farmer's reach.

A Building Study of 60 Missouri Farms[1]

B. J. C. Wooley[2]

THE need for information on the optimum investment in building equipment on any farm is apparent to all who are connected in any way with design. The planning of a barn is an economic as well as an engineering problem. Return on the investment in just as essential when money is expended for buildings as for any other investment. There is much divergence of opinion among engineers as to what constitutes the optimum investment for any farm. The present day investment in building equipment is the farmer's answer to this problem. He may tell you that he needs more buildings, but the fact that he does not build them indicates that he does not believe they will make him as much money as some other investment. He finds money to do other things even in hard times, and therefore we must conclude that "present practice" represents the farmer's idea as to the proper investment in this branch of the business. A cooperative study of present practice is being made by the departments of agricultural economics and agricultural engineering of the Missouri Agricultural College. This study is to cover three hundred farms, one hundred to be located in one of our most productive, one hundred on a medium, and one hundred on one of our least productive soil areas.

In the fall of 1929 eighty farms located on one of our best soil types, the Marshall silt loam, were studied. During the past fall 110 farms on a medium soil type have been surveyed. During the coming season it is planned to survey one hundred farms on one of the least productive soil types still used for agricultural purposes.

[1]Paper presented at a meeting of the Structures Division of the American Society of Agricultural Engineers, at Chicago, December, 1930.

[2]Professor of agricultural engineering, University of Missouri. Mem. A.S.A.E.

Fig. 1. Present practice as to original investment in all buildings, in service buildings and present worth of service buildings on 60 farms

The objectives of this study, from an agricultural engineering point of view, are as follows:

1. To determine what is common practice in regard to investment in farm buildings
2. To determine the effect of a variation in this investment on labor income
3. To determine the annual cost of farm buildings
4. To determine the place of farm buildings in the cost of production
5. To determine the effect of efficient farm and farmstead layout on the utilization of labor on the farm
6. To secure ideas for improvement in future design of farm structures.

Methods of Securing Data. The so-called survey method is used in securing data for figuring the labor income of the operator. A map of the farm showing location of fields, fences, ditches, swamps, etc., is made. The size of all fields is computed and the kind of crop noted. The acreage of waste land and the acreage in the farmstead is computed. A detailed map of the farmstead is drawn to a scale of 100 feet to 1 inch. This shows the buildings, trees, fences and gates. Contours are drawn in freehand to show general direction of drainage, steepness of slopes, etc. Each building is studied in detail from a schedule sheet. Each is numbered on the farmstead plan and on the schedule sheet accordingly. As soon as the farmstead map is completed a book of schedule sheets is made up one for each building on the farmstead. The schedule sheet is divided into five parts: (1) Historical data to be secured from the farmer; (2) cost and service data; (3) capacity for feed, livestock or machinery; (4) construction, and (5) depreciation and its causes. On some farms a full half day is needed to complete the study while on others the study can be completed in two hours.

Appraisal of Buildings. The depreciated replacement cost was used to secure the value of buildings. The number of cubic feet within the building multiplied by a cost unit for the type of structure gives the replacement cost of the building. Knowing the date when the building was constructed and having the farmer's and the investigator's estimate as to its future service, we can figure the total years of service, its present worth and the annual depreciation cost. A straight line depreciation was used

Table I. Effect of Investment in Buildings on Labor Income

	20 least profitable farms	20 most profitable farms	Average for all farms	Highest labor income
Representative cost, service buildings	$3078.91	$4709.08	$3694.86	$8553.30
Present worth, service buildings	1631.15	2526.65	2405.07	6510.00
Replacement cost, service buildings, per acre	23.46	21.00	22.38	35.63
Present worth, service buildings, per acre	10.57	11.30	11.31	27.12

Table II. Annual Cost of Service Buildings

Farm No.	Interest	Repairs	Depreciation	Taxes	Insurance	Total	Annual cost per annual unit	Annual cost per acre	Annual cost, all buildings	Annual cost, all buildings, per acre
68	$58.06	$19.85	$ 67.00	$ 7.45	$ 0.93	$153.31	$ 6.98	$ 0.53	$463.85	$ 1.60
29	75.57	29.95	77.97	9.33	1.17	189.99	6.87	1.36	403.82	2.88
12	119.78	41.10	129.35	11.04	1.38	302.62	12.76	1.89	576.45	3.60
36	79.50	27.25	92.53	15.38	1.92	216.58	11.13	2.71	334.69	4.31
50	79.72	27.37	85.17	3.90	0.97	197.13	9.85	2.46	402.81	5.04
				(50 intermediate farms omitted)						
16	130.92	45.00	143.53	20.97	2.62	343.04	2.25	1.07	891.40	1.84
5	118.50	40.60	118.31	21.68	2.71	301.80	3.83	1.16	601.43	2.31
23	250.51	86.01	155.93	20.25	5.06	517.76	11.01	2.45	699.01	3.31
15	113.62	38.90	87.18	17.21	2.15	259.06	2.47	0.84	340.84	0.96
2	256.59	88.00	265.12	52.08	6.51	668.30	3.05	2.78	1248.52	5.20
			Total for 60 farms -			$16,669.91	$479.58	$92.45	$29,854.35	$179.00
			Average for 60 farms -			277.83	7.99	1.54	497.57	2.98
			Average for 20 least profitable			222.75	9.03	1.46	443.32	2.94
			Average for 20 most profitable			333.18	6.39	1.52	559.86	3.06

NOTE: The annual cost of farm buildings on the twenty most profitable farms was $6.39 per animal unit as compared to $9.03 for the least profitable group, $7.99 being the average for all. The decrease in cost per animal unit on the more profitable farms was due to better utilization of buildings rather than to cheaper construction. (See TableI.)

Table III. Items in the Cost of Production						
	Interest	Insurance and Veterinary	Pasture	Roughage	Concentrates	Buildings
20 least profitable	$193.02	$ 51.24	$365.37	$343.55	$2793.75	$224.60
20 most profitable	404.21	27.38	385.65	644.90	4072.25	333.18
Average of all	265.80	31.39	424.96	511.94	3173.66	271.01
Percentage of total average cost	5.64	0.67	9.08	10.94	67.86	5.79
Percentage on most profitable farm	5.65	0.40	5.91	13.23	70.98	3.80

since the value of the building so far as service is concerned is about the same during its life.

About eighty-five buildings had been built within the year and cost data from these aided in making up the table on unit cost. These figures vary between the limits given, due to a difference in the quality of material and of workmanship used, as follows:

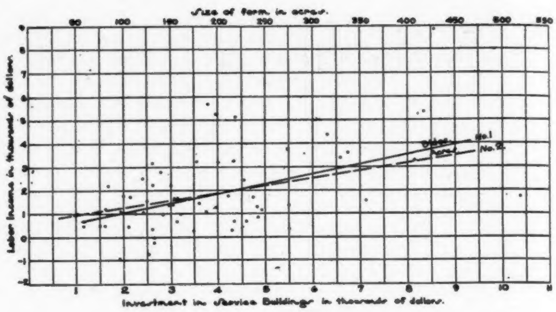
Hay and feeding barns, posts set in ground, no foundation —2½ to 4 cents
Hay and feeding barns, timber frame, rock or concrete foundation—3 to 5½ cents
Beef cattle feeding barns, balloon or timber frame, concrete foundation—3 to 6 cents
Dairy barns, concrete foundation and floors, steel equipment—4 to 6½ cents
Cattle and machinery shelters, posts in ground, no foundation—2½ to 5½ cents
Cattle and machinery shelters, timber frame, concrete foundation—4 to 7 cents
Garages, balloon or timber frame, concrete foundation and floors—6½ to 10 cents
Garages, posts in ground, dirt floor—3 to 6 cents
Poultry houses, posts in ground, dirt floor—3 to 6½ cents
Poultry houses, balloon or timber frame, concrete floor—5 to 8½ cents
Corn cribs, posts in ground, wood floor—3½ to 6 cents
Brooder houses and feed hog houses—6 to 15 cents
Granaries, timber frame, concrete foundation—5 to 10 cents
Farm houses, modern brick veneer or stucco—35 to 40 cents
Farm houses, semi-modern, good construction—20 to 30 cents
Farm houses, not modern, fair construction—15 to 20 cents.

Fig. 1 shows graphically the total investments that have been made in farm buildings on these sixty farms. Curve No. 2 represents the replacement or new cost of the service buildings on these farms, and No. 3 represents the percentage worth of service buildings.

While there is a wide spread or variation between extremes as shown on the scatter diagram, a comparatively high percentage of the cases follow the curve representing the average "new" cost of buildings. The difference between Curves No. 1 and No. 2 represents the investment for living. On the smaller farms the investment in building equipment for living is greater than that for service buildings or buildings for business. Considering the sixty farms, the investment in the dwelling, fuel houses, etc., make up 51 per cent of the building investment. In this group of farms 23 per cent of the homes were modern and 32 per cent semi-modern, leaving 46 per cent with no modern equipment.

Curve No. 3 represents the present worth of service buildings. The spread between Curves No. 2 and No. 3 denotes the degree of depreciation existing. Curve No. 3 gives the average value of service buildings on the different sizes of farms studied. Fig. 2 shows two curves, one to show the effect of increased acreage on labor income and the other to show the effect of increased investment in farm buildings. Curve No. 2 was transformed in order to show a comparison of the two curves. Further work is necessary on this particular phase of the study in order that the influence of each of these variables may be determined.

Annual Cost of Farm Buildings. Probably too much attention has been given to the first cost of farm buildings and not enough to the annual cost which is the factor of greatest importance. This does not mean necessarily that permanent structures should be built, although this usually decreases the annual cost. The changing times and types of farming may call for different kind of buildings. Many of the farms studied were equipped for a much more intensified beef cattle program than was being carried on in 1928. These buildings were not a complete loss, but most of them were too good to tear down and were not well suited to the new program.



The annual cost of farm buildings is made up of five different elements, as follows:

(1) Interest. The interest charge was figured on one-half the replacement cost and at the rate of 6 per cent.

(2) Repair Charges. These charges based on 1928 figures were found to be $1.03 per $100 replacement cost.

(3) Annual Depreciation. The method of computing this figure has already been explained.

(4) Taxes. Taxes were figured at 40 cents per $100 of present worth.

(5) Insurance. This was figured at 10 cents per $100 of present worth.

Table II gives the five farms having the lowest labor income and the five having the highest labor income. Lack of space prevents giving the data on all farms.

Place of Buildings in Cost of Production. The cost of production on these farms is based on the cost and returns from animals, because the animals and their products were practically the only source of income, very little if any grain, truck or other products being sold. The cost was made up of six items: (1) Interest on the investment in animals, at 7 per cent; (2) insurance and veterinary, 0.5 per cent of the investment in the animals; (3) pasture; (4) roughage; (5) concentrates, and (6) buildings. Lack of space makes it impossible to give the data for each farm. Totals only are given.

The studies of efficiency in utilization of labor are being based on the normal time for production of crops and the normal time required to care for an animal unit of the various kinds of livestock and poultry. The normal time for these divisions of farm work is secured from the record keeping farms now cooperating with the agricultural economics department. From these figures the effective hours of labor that has been done on the farm can be computed. This divided by the man-hours available on the farm gives the efficiency in use of labor. Many are below the normal, but one or two have an efficiency rating of approximately 300 per cent. Lack of care of roof drainage, inadequate foundations, foundations too low, lack of mechanical repair, and lack of paint are some of the most common causes of failure. Probably the greatest loss in farm buildings comes from lack of use, due to the fact they do not fit into the scheme of farming now being used, or more often to the fact that the farmer is not carrying on as large a livestock program as his buildings would warrant. Only about one-sixth of the farmers planned the buildings they are now using.

Money invested in buildings must be put to work if returns are to be expected.

Cooling as a Factor in Sanitary Milk Production[1]

By A. C. Dahlberg[2]

WHENEVER the subject of sanitary milk production is discussed attention must be given to the cooling of the milk. So important is milk cooling that a few years ago an editorial was published in which the substitution of the thermometer for the bacterial count was recommended. There would have been much more merit in the proposal if it were possible to cool utensils as well as milk or to check the extent of their contamination by some certain methods. Nevertheless, the proper cooling of milk is of major importance in sanitary milk production. There is no necessity for amplifying its value as it is well known.

There are three important factors to consider in proper cooling milk, aside from cost, namely, (1) the final temperature of the milk and the speed with which it is attained, (2) the ease with which the temperature may be maintained or the refrigeration losses, and (3) the simplicity of the equipment. These problems will be considered in the light of investigations which have been conducted by J. C. Marquardt and the author at the New York Agricultural Experiment Station. The material is being presented as the study was undertaken with the final recommendation that fresh milk of good flavor should be placed immediately after milking in a well-insulated tank at 40 degrees (Fahrenheit) without previous cooling or subsequent agitation. No attempt is being made to give you any technical engineering information on refrigeration but to simply present the problem as it has been studied from the viewpoint of the farmer and what he needs to know.

A herd of 26 registered Jersey cows is maintained at the station and for years no adequate and entirely satisfactory method of cooling their milk was available. It was decided that some experimental data of value might be collected by the installation of a suitable cooling tank, tubular cooler, and mechanical refrigerating unit.

The Cooling Tank. Several essentials were considered in the construction of the tank. There is need of sufficient size to hold the required number of cans and still provide room to contain plenty of water and ice or refrigeration coils. We figured our daily milk production plus a can of skimmilk for calf feeding would require the cooling of six 10-gallon cans of milk (516 pounds). In constructing a tank for this capacity allowance was made for rapid cooling either by immersion of cans within the tank or by circulation of water through a tubular cooler. In either case the refrigeration requirements would be practically the same.

The inside tank was constructed of 14-gauge boiler plate and after completion was painted with asphalt. It cost about $25.00 to construct. The steel tank was used instead of concrete because certain refrigeration engineers advised me that as ice froze against the walls of the tank the concrete might chip on account of its porosity. It is now known that this theoretical advice was not correct. Concrete construction for ordinary purposes is both cheaper and more permanent. Since the two concrete walls ought each to be 4 inches thick and with 3 inches of cork, the total wall thickness of 11 inches is rather excessive for convenient handling of cans. It might be better to plaster the cork on the outside with concrete or to use some other durable, thin, waterproof material. The size of the inside tank was 35 by 60 by 26 inches with the 1½-inch overflow pipe set to give a water level of 20½ inches. Eight cans could readily have been placed in the tank, but it was believed that six cans were sufficient, considering the need for cooling water and ice. The tank was placed in the corner of a room so that the wall could be used for two sides and that it would occupy a minimum space.

Such a tank holds 182 gallons of water which allows 2 gallons of water for every 1 gallon of milk when the tank is filled. A little calculation will show that with water in the tank at 40 degrees warm, fresh milk at 90 degrees will be cooled by the water alone to 57 degrees when six cans are placed into the tank and to 47 degrees when three cans, the usual amount, are used. It is necessary for rapid cooling that there should be a reserve supply of refrigeration in the water. For three cans of milk about 75 pounds of ice would need to melt to reduce the temperature of the milk and water to 40 degrees. This quantity of ice can readily melt from cakes within a couple of hours and the large pieces of ice would hold better than chipped ice over 24 hours, not to mention the reduced labor cost of handling ice. Unless a large amount of water is available it would be necessary to chip the ice and replenish the supply later.

For mechanical refrigeration by small electrical units there is need of a minimum drain on the capacity of the compressor at any given time. Our tank is connected with a 21X Frigidaire coil. With this coil the reserve ice supply must do the rapid cooling as evidenced by the fact that hours would pass before the machine would produce sufficient refrigeration to cool even three cans of milk to 40 degrees.

The insulation of the cooling tank was accomplished by a 2-inch and a 1-inch layer of compressed cork set with asphalt and with lapped joints. Now 3 inches of cork is about $25.00 worth of insulation and it may be that 2 inches would have been sufficient. At least we used enough. Perhaps some other substance might be more readily available and cheaper for farmers. The U. S. Bureau of Standards has determined the heat losses in B.t.u. per hour, per square foot of material, per 1 degree gradient in temperature, and per 1 inch thickness for common insulating materials as follows:

Material	Heat Loss
Corkboard (average density)	0.30
Celotex	0.34
Insulite	0.34
Flaxlinum	0.31
Fibrofelt	0.32
White Pine (dry)	0.78
Oak (dry)	1.02
Brick	3.0 to 6.0
Concrete	6.0 to 9.0

It will be noted from the table that several common materials are approximately equal to cork in insulating value while concrete is only one twenty-fifth as efficient. Too much stress cannot be laid upon the proper coating of insulation with asphalt to keep it dry.

Data from carefully controlled conditions are essential for science, but one often wants to know just what happens under practical conditions. Various factors affect

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at Rochester, New York, October, 1930.

[2]New York (Geneva) Agricultural Experiment Station.

A view of the electrical refrigeration equipment used in the milk cooling study conducted by the author at the New York (Geneva) Agricultural Experiment Station and reported in the accompanying paper

such tests as the one and one-half feet of stone wall bordering two sides of the tank, the ground surrounding more than the entire lower half of the tank, etc. Consequently the heat losses through the insulated tank and through a non-insulated tank with 4-inch concrete walls were determined. The trial was made on several days, but that of July 25, 1928, was typical. The air temperature varied from 82 to 80 degrees. The water in both tanks was 42 degrees at the start and the test lasted for 24 hours. In the non-insulated tank 288 pounds of ice were placed and 40 pounds were left after 24 hours. The water warmed to 43 degrees making a total refrigeration loss of 258 pounds of ice. In the insulated tank the original 94 pounds of ice reduced to 22 pounds and the water in the tank lowered to 39.5 degrees, thus making a loss equivalent to 46 pounds of ice when the water temperature was considered. The 3 inches of cork saved 212 pounds of ice in one day which at five dolars per ton was worth 53 cents. If we assume similar losses for five months per year the insulation saved $80.00, or three times its cost in one year. It should not be assumed that 3 inches was the best thickness of cork to use but rather that thorough insulation was profitable. Leaks in the insulating installation reduce markedly the efficiency of the insulating material. Manufacturers of tanks have given much thought to this point.

Can vs. Tubular Cooling. There are ample data in the literature to demonstrate that milk cools very slowly in a 10-gallon can immersed in ice water, that it cools much more rapidly when stirred, and that for best cooling the milk ought to be tubular cooled before placing the can of milk in the tank of water. There can be no doubt whatever concerning the absolute necessity of tubular cooling of milk to be set in a cold air room because air cools milk so slowly. The proposition of the absolute necessity of rapid tubular cooling of fresh milk before placing it in ice water may be entirely different when a well-insulated tank of ample capacity is used.

Milk freshly drawn from the udder of the cow ought not to require the rapid cooling necessary to maintain a low bacterial count such as is known to be the case for aged milk. That bacteria fail to develop and mulitply in most samples of freshly drawn milk has been well established, although there may be some doubt concerning the proper explanation of this phenomenon. At the beginning of this century milk was found to have a germicidal action, but recently there has developed a belief that the effect is due to the changed environmental conditions of the bacteria or to the lag in bacterial multiplication preceding growth. Be that as it may, Hunziker in 1901 extended the study on this subject and found that bacteria decreased in freshly drawn milk, particularly when stored at 70 degrees. A few years later Stocking verified the results but noted an exceptional sample in which the bacteria had increased in 3 hours at 70 degrees. He cautioned that "immediate cooling" is necessary due to irregularities in the milk. In 1922 Macy found that under practical farm conditions the count of uncooled milk scarcely changed in an hour but after two hours some samples began to give higher counts.

In this investigation the milk was cooled in three ways, namely, (1) the can of freshly drawn milk was set into the tank of water without previous cooling, the lid was tightly put in place and the milk was not agitated in any way; (2) the milk was treated as in the first case, except that it was stirred after one and two-hour periods, and (3) the milk was cooled by a surface tubular cooler to the required temperature before placing in the tank of water. Mention should be made of the fact that the stirring rod was washed and rinsed with hot water after each usage and was steamed in a tin cabinet for 10 to 15 minutes once a day. The tubular cooler was washed with a Diversol solution, rinsed with hot water, and then with a luke warm Diversol solution. (Diversol contains chlorine for disinfection.)

After the cans were filled with milk at the barn, the entire amount was mixed together and divided into three cans which were sampled for bacterial counts and cooled according to the three described methods. After 24 hours samples were again taken for bacterial counts and the milk was often examined for flavor and odor. Only a limited number of tests were made with tubular cooled milk due to a shortage of supply and the desirability of complete data on the other cooling methods. In these studies the tank was held at temperatures ranging from 35 to 60 degrees. Milk with high bacterial counts was secured by complete disregard of sterilization of the milking machines.

The data for tubular-cooled milk were incomplete but it is well known that approximately 50 degrees is the critical temperature above which the bacterial count of milk increases markedly in 24 hours. In some instances the passage of milk over the cooler gave noticeable increases in count.

The results of real significance are that the bacterial content of can-cooled milk did not increase in 24 hours and that stirring was of no value when the water in the tank was below 42 degrees. The large well-insulated tank with plenty of available ice enabled this easy method of cooling to give excellent results. There was no increase in bacterial count of milk placed in water below 40 degrees, and if these results are indicative of what might be generally expected, then the highest quality of

milk can be maintained by can cooling without stirring. As a matter of fact equally good results were secured at 40 to 45 degrees, but we favor 40 degrees or less for grade A milk because of the added safety against mishaps. For ordinary market milk for pasteurization the results show that a temperature under 50 degrees for the water in the tank would be ample. However, in an insulated tank it is almost impossible to have ice in the tank continually without securing colder temperatures. Even in non-insulated tanks a temperature of 50 degrees can be maintained if a tank of sufficient size is supplied with ice.

There is a popular belief, with certain supporting evidence, that the growth of bacteria in milk containing millions of organisms is more difficult to check than in milk of low-bacterial content. Although the data presented on this point are somewhat meager, they fail to show any difference in the temperature required to check bacterial growth due to total count.

Considering the failure of bacteria to develop in can-cooled milk, the rapidity of cooling is of special interest. When the milk was in water at 35 to 40 degrees and was stirred after one and two-hour periods, the temperature was around 60 degrees in one hour and at 50 degrees at the end of two hours. Whenever the temperature of the milk was at 70 to 80 degrees as it was placed in the tank, it dropped to 50 degrees within an hour. Several thermometers were set at various places in the unstirred can and the temperature was recorded at 10-minute intervals for periods of 4 hours. The milk was rapidly cooled at the sides of the can and in the center at a point near the handles of the can, and it is safe to assume that the milk below this point was cooled even more rapidly. The point of special interest was that about an inch below the neck and in the center of the can. It should be stated that all cans were completely filled with milk. At this location in the can the milk cooled so slowly that the temperature was below 60 degrees only after 4 hours cooling.

There may be two reasons why the counts were not increased in spite of the slow cooling at the surface of the milk, namely, (1) the so-called "germicidal action" of the milk, and (2) the small amount of milk involved. The shoulder of the can is narrow at the top and probably not over 2 or 3 quarts of milk are concerned. We will continue a study of this portion of the milk to learn if the bacteria actually multiply.

MANNER OF COOLING

Cooling with Ice. Ice has not been given an opportunity of doing its best on dairy farms because cooling tanks have been too small and without insulation. During the past summer we have cooled milk with ice in a tank insulated with 3 inches of cork. From 175 to 200 pounds of ice was required to cool six 10-gallon cans of milk from 85 or 90 degrees to 40 degrees.

Several interesting results were obtained with ice in the insulated tank. The temperature of the water was held at 36 to 40 degrees during the hot summer months and the cakes of ice were not broken into pieces. The temperature of the milk was reduced to 50 degrees in approximately one and one-half hours and by the following morning the night's milk was always below 40 degrees. These temperatures are much colder than were anticipated.

When milk must be cooled more rapidly to comply with ordinances or for shipment soon after production, the rate of cooling can be increased by rapid agitation of the water. It is possible to lower the temperature below 50 degrees in one hour without stirring the milk by means of water agitation.

Electric Cooling. Within a couple of weeks after the cooling tank was constructed in April, 1928, a Frigidaire air-cooled compressor operated by a ½-hp. motor and one 21X coil in the tank was installed. It was readily shown that this apparatus had to rely on ice frozen on the coil to furnish ample refrigeration when needed and to store up refrigeration as the machine ran throughout the day and night. Furthermore, the ice cake was too nearly cubical in shape and the exposed ice surface was much too small to handle the irregular refrigeration demands. A brine tank was constructed to extend nearly across the water tank so that the ice would have greater exposed surface and would melt more readily. A calcium chloride brine having a specific gravity of 1.2 (3 pounds chloride per gallon of solution) was satisfactory to prevent freezing on the coil. With this installation the water at the top of the tank was usually below 45 degrees even after warm milk was set in the water.

At the beginning of this study it was believed that the milk ought to be tubular cooled using running water as the cooling medium to effect refrigeration economies and to secure more rapid cooling. Consequently the milk was tubular cooled at the barn milk room from June to November 1928, inclusive. We recognized that the use of the cooler enhanced the possibility of utensil contamination, increased the labor of handling milk, and wasted much water but saved refrigeration. Since December 1928 the tubular cooler has not been used in handling our milk and there is little possibility of reintroducing its use with our present attitude toward its value.

DATA TAKEN DAILY

Data have been secured daily on the temperature of the air, the initial and final temperature of the milk, the kilowatt-hours used, the temperature of the water in the tank, etc. The amount of ice that would have been used in place of electricity has been calculated with approximate accuracy and has been experimentally determined. The results show that on a yearly basis 1.08 kilowatt-hours of electricity were employed to cool 100 pounds of milk, a result based on 13 months' operation. During the past year records have not been kept on electric costs. The cost depends on the electric rate in any locality and would be 5.4 cents at the rate of 5 cents per kilowatt-hour. By calculation it was shown that 29 pounds of ice would have been needed to do the same task which at $5.00 per ton would be 5.8 cents. These costs are but a part of the total, for with the electrical refrigerator there is the original investment, depreciation, and an annual service which we believe ought to be regular. With ice there is the enormous shrinkage to consider, the original investment in the ice house and its lower depreciation, and the disagreeable, wet task of handling ice in the summer when time on the farm is at a premium. The electrical refrigerator requires a simple temperature adjustment in the spring and fall.

In the winter months it may be possible that no refrigeration from the machine should be used for the tank could be exposed to freezing temperatures and the temperature regulated by the length of the exposure. Nevertheless until more data are available it is unsafe to recommend either the water tank without some source of refrigeration or can cooling in the air if high quality milk is desired.

There are special problems to be considered in securing all necessary information on artificial refrigeration as it applies to the dairy farmer, but there can be no doubt concerning the future of this process on the larger dairy farms producing milk of high quality. The certainty of a constant supply of refrigeration, the elimination of the muss from ice, and the saving of labor when labor is at a premium are advantages of value to the producer of milk.

The Cooling Problem. Except for occasional sporadic udder infections there are but two outstanding essentials in the control of the bacterial content of milk, namely, the prevention of contamination due to contact of the milk with utensils and apparatus, and the prevention of bacterial multiplication by cold temperatures. Much has been done on all phases of milk sanitation, but in the cooling of milk there has been little progress or improvements in equipment until the last few years It is true that

better cooling methods have been urged and improvement in procedure has been made, but the progress has not been marked like the introduction of approximate sterilization and drying of cans, etc.

The first and one of the outstanding contributions of the manufacturers of small refrigeration units for dairy farm use has been to establish the value of insulation in cooling tanks and boxes. Their units were small and expensive to operate, as the meter clearly showed, unless the cold was conserved by insulation. Our data clearly demonstrate that insulation pays for itself in a short time and is essential for uniform and cold temperatures. Furthermore, an insulated tank will give temperatures, even with ice, far below those which were assumed to be possible in water cooled by ice cakes. The fact that a 70-pound cake of ice reduced the temperature of 1540 pounds of water at 42 degrees over a 24-hour period in the month of July clearly illustrates the possibilities. The saving of ice, electricity, or other source of refrigeration is not the only value of insulation. Insulation on a tank of suitable size has made it possible to cool milk in a 10-gallon can by immersion in water, thereby eliminating the necessity of using a surface cooler or of stirring milk in the can.

There is now an opportunity of assisting the dairy farmer and improving the milk supply, by taking an active part in the promotion of insulation for use on the dairy farm. The farmer must be confused by the ever-increasing devices for rapidly cooling milk in cans or before pouring it into cans, by the claims for the merits of various manufacturers of insulation, by the problem of the necessity of using an insulation other than concrete which has little value, by the problem of installing a mechanical or heat refrigerator or none, by the various ideas concerning the need of surface coolers and the stirring of milk in cans, by the belief that misleading term "animal heat" must be allowed to escape into the air, and by the exact temperature to which the milk ought to be cooled. There ought to be more simple plain statements of the principal factors in milk cooling.

The essentials of proper milk cooling as this study has shown are very simple, namely:

(1) The cooling tank should be large enough so that when filled with cans of milk there will be twice as much ice and water as milk. Although this tank is large it is necessary for can cooling.

(2) Insulation with 3 inches of cork, or its equivalent, protected against becoming wet saved more than its cost in refrigeration in one summer. The insulation is essential for maintaining a low temperature, although 3 inches may not be necessary.

(3) Milk can be satisfactorily cooled by placing it immediately after the can is filled at milking time in cold water at 40 degrees, providing the tank is of ample size, well insulated, and a large enough source of refrigeration is available. The milk need not be stirred or surface cooled. Should stirring be thought to be desirable, one stirring after one or two hours in the water is ample. For milk of bad flavor, such as absorbed feed flavor, aeration may be desirable.

(4) Ice has not been given a real opportunity as a refrigerant on dairy farms because of lack of insulation in cooling tanks. Ice will maintain temperatures below 40 degrees in insulated tanks of ample capacity.

(5) The electrical cooling of milk appears to be practical. The machines need little attention, are reliable, economical (although depreciation is an unknown quantity), a source of constant refrigeration, and a great convenience as they save the labor of handling ice during the busy summer months.

Seven Major Objectives in Land Utilization[1]

THESE conditions emphasize, though they do not create, the need for a rational land-utilization policy. Such a policy (1) calls for a scientific classification of our land resources, so that crop, pasture, and forest requirements may be more efficiently met. Knowledge of land resources is indispensable to the wise direction of production. (2) The contraction of farm acreage is necessary in some areas, and a check upon its expansion is necessary in others. (3) Steps should be taken by public agencies, local, state, or federal, to divert tax-delinquent lands or lands obviously submarginal for farming purposes to other than farm uses. () Our national reclamation policy should be reconciled with the need of restricting farm production. (5) Public reforestation should be pushed. (6) Our public-domain policy should equally serve the interests of the local farming and grazing industry, the interests of agriculture as a whole, and the interests of the Nation. (7) Information should be made available to guide private enterprise in land settlement.

These points need not all be discussed in detail, though one or two may be amplified. It is particularly important to foster the contraction of farm acreages in unprofitable areas and to discourage expansion in others. Recent technical progress in American agriculture has changed our agricultural map considerably. Expansion in some areas has created distress in others. This is one of the inevitable penalties of progress. Special cotton growing on large farms in Texas and Oklahoma has put a heavy handicap on extensive areas in the Old South where boll-weevil infestation is heavy. Tractors and combines have caused a marked concentration in the production of wheat in the Great Plains area. In the States to the east wheat growing has declined.

[1]From the Report of the Secretary of Agriculture, 1930.

Farming by the old methods, in fact, has become unprofitable in extensive areas, and much acreage has been abandoned and become tax delinquent. Often, however, the abandoned farms are resold instead of being excluded from crop production. It should be an essential aim of our agricultural policy to facilitate the withdrawal from agriculture of acreages that seem likely to remain unprofitable. Public provision should be made for the utilization of this land for purposes other than farming. This is not possible in many states under existing laws, which generally provide for the resale of tax-delinquent lands. There seems to be an opportunity here for federal cooperation with state and local governments to promote the economic stability of distressed areas. A study should be made to determine what classes of land are ill-adapted to private cultivation, grazing, or timber growing, and to indicate what benefits might be derived from the public acquisition of such areas. . . . . .

The public acquisition of idle lands, though in contrast with our historic land policy, seems justified by present conditions and by changing national objectives. Land not immediately needed for crops or pasture often suffers under private ownership or control. Private interests seldom do much to protect stream flow, to prevent erosion, or to conserve game and fish. Often, under the pressure of heavy carrying charges, they try to push idle land into agricultural uses, whether that is economically sound or not. This is easy in times of temporary agricultural prosperity, but the practice leads to distress. Public ownership of lands that can not be profitably farmed would, in many areas, mean a better economic use of the lands in question, and also do something to relieve the pressure of unneeded production upon the markets.

Garden Tractor Development and Application[1]

By A. A. Stone[2]

WHAT is a garden tractor? Machines of this class are referred to as motor cultivators, power hoes, auxiliary farm tractors, garden cultivators, one-horse tractors, etc. Some manufacturers object to calling them tractors. But the term "garden tractor" is in general use and perhaps is better than any other. For the purpose of this discussion let us assume that "garden tractors" include all such machines capable of operating one 12-inch plow or less. This will establish certain limits, although the dividing line between some of the larger garden tractors and some of the smaller farm or field tractors is not very clear.

Within the limits we have just set up there is great variation as to weight and horsepower. The smallest one listed this year weighs 165 pounds and has a one-horsepower engine; the largest weighs 1250 pounds and has a ten-horsepower engine. It is perhaps not necessary to say that the former is not used for plowing. The larger one, however, operates a 12-inch plow satisfactorily under most conditions.

I want to review briefly the history of garden tractor development.

The accompanying graph shows the rapid increase in the number of manufacturers and their total output. The number of manufacturers increased from eleven in 1919 to thirty-three in 1921. Production jumped from 3700 in 1919 to 7700 in 1920, but when the years of agricultural depression set in at about this time both curves show an abrupt drop. Many of the manufacturers were small concerns, not adequately financed to weather the lean years. No doubt quite a number found that their product did not prove satisfactory and were without the capital necessary to carry on its improvement. Some of the stronger companies survived and continued manufacture and improvement. This year there are fifteen listed, but there are only ten or a dozen active producers. In most cases their product has come to be a standard article of equipment in enterprises suited to their use, as will be mentioned later.

Farm and garden tractors have passed through corresponding stages of development, including the following:

1. The predominance of large, heavy types in the early years.
2. A rising tide of production and number of producers until 1920-21, followed by an abrupt drop in both, resulting in the elimination of the weaker companies.
3. A very marked tendency about 1920 toward lighter and smaller models—two-plow outfits in the farm tractor class and garden cultivators in the garden tractor class.
4. At about the same time attempts to produce outfits to be coupled to horse-drawn implements and hand tools already found on the farm.

It has been clearly demonstrated that to get a real general-purpose farm tractor, the integral design of the tractor and its implements is necessary. Special tractor implements of the proper size and strength are required. Horse-drawn implements were not adequate for use with farm tractors. We are now coming to see the analogy in garden tractors and their equipment. Special tools and implements, hitches, steering or guiding controls, depth adjusting levers, tool carriages, etc., are necessary. In other words, integral design of the power unit and implements is just as vital here as it is on farm tractors. Simply gearing an engine to a pair of light cast iron wheels and bolting on a few wheel hoe tools does not answer.

Present tendencies in farm and garden tractor industries are also similar. The two-plow farm tractor is being replaced by the general-purpose types. Some are growing up into three-plow units. The power take-off has been added. It is extending the usefulness of the farm tractor in many new directions, and greatly increasing its ability to replace horses. In fact, the immediate future of the farm tractor development is closely bound up with the power take-off and the general-purpose or row-crop machines.

The same condition is now evident in garden tractors. Power is being increased. Some concerns are making two models—the small garden cultivator, for which there may always be a steady demand; and a larger model capable of light plowing as well as narrow row cultivation. Some provide a power take-off and it seems to be working out to good advantage particularly on field mowers, but it is used for other operations also. There are a few models on the market that might be termed general-purpose garden tractors.

It has been said that the problem of the designer of a general-purpose farm tractor was to create "a plowing outfit that would cultivate." The problem of the designer of a general-purpose garden tractor may be even more complicated. If he makes a machine powerful and heavy enough for real plowing, it may become too heavy and not flexible enough for cultivating the narrow

(Extreme left) A single drive-wheel garden cultivator being used to weed potatoes. (Left) A garden tractor with riding attachment and 10-inch plow turning under a field of 4-foot rye

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Rochester, N. Y., October, 1930.

[2]Professor of farm mechanics, State Institute of Applied Agriculture. Mem. A.S.A.E.

row crops of the market gardeners and truck farmers, who are the chief users. If he makes it light and flexible enough for such cultivation it may be too small for plowing. If a machine can be made to do both jobs well, it deserves full well the distinction of being called a general-purpose garden tractor. The present tendency among manufacturers is to try to produce machines which will answer these requirements, as it seems evident that the demand for such a machine would far exceed that for machines limited to special operations.

A general-purpose garden tractor is desirable for the following reasons:

1. Many owners of small acreage cannot afford to purchase a machine for cultivating only and have to employ other means for their plowing.

2. Professional market gardeners harvest crops off small patches of ground several times a season, and may have occasion to plow these plots or beds three or four times per year. If the little power cultivator with which they tended these crops had sufficient power to do satisfactory plowing, they would be glad to use it.

3. More power would make the use of multiple-row units more common and thus speed up the work.

4. If a machine suitable for cultivation of narrow-row crops had sufficient power for good plowing, it would have ample power for the deeper cultivation that might be necessary in the wide-row truck crops.

For these reasons I believe that small garden cultivators are going to grow up and perhaps some of the larger garden tractors, which now do satisfactory plowing and wide-row cultivation, will be adapted to narrow-row cultivation. Both classes will tend toward a true general-purpose type. I believe this would be desirable, and I hope that present tendencies along this line continue.

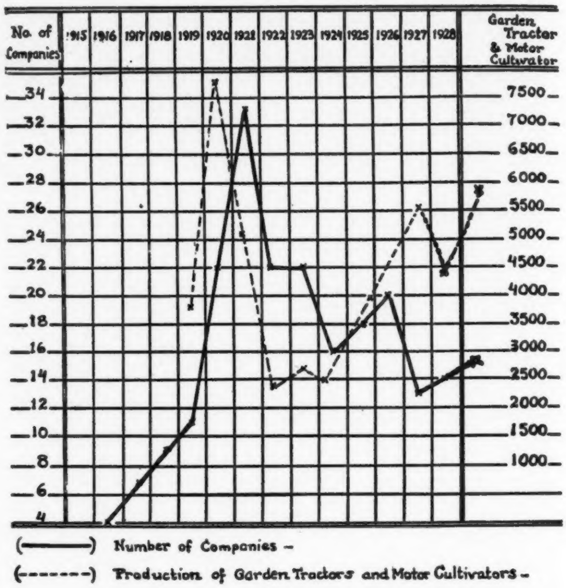
I want to present some considerations that, in my opinion, are important factors in the design of garden tractors of this class. Most all of these have been found necessary in general-purpose farm tractor design, and they apply to garden tractor design also.

REQUIREMENTS OF A GENERAL-PURPOSE GARDEN TRACTOR

1. Sufficient power to operate a 10 to 12-inch plow
2. Interchangeable lug and wheel equipment to secure traction
3. Variable tread, adaptable for multiple-row work
4. Adaptability for cultivating narrow rows as well as the wider rows of truck and market garden crops
5. Lateral stability
6. Ample vertical clearance
7. Vine turners or plant shielding devices
8. Adequate depth adjusting, spacing and tool lifting mechanisms
9. Accurate, quick-acting cultivator control
10. Easy interchangeability of attachments
11. Easy handling, short turning, and reverse gear
12. Power take-off and belt pulley equipment.

There are a few machines on the market now that answer many of these requirements. Perhaps this development will come, or it may be that future years will show that such a machine cannot be made. But I do not believe that the problem of designing the general-purpose farm tractor was any more difficult than this one is, and in four years general-purpose farm tractors have come to account for nearly 1/5 of the total farm tractor production. Since 1926 their production has doubled each succeeding year. I feel that there will be a similar demand for a general-purpose garden tractor.

Although it is natural to look for improvement and betterment in the future and perhaps quite fitting to make frank suggestions as to changes in design, it would be



Graph showing the history of the garden tractor and motor cultivator industry in terms of the number of manufacturers and total units produced

unfair to leave the subject here, as this might indicate that the present situation is entirely unsatisfactory. This is not the case.

Let us now survey the present situation. To obtain information on this point a questionnaire was sent on May 10, 1929, to all the owners of garden tractors on Long Island (New York) whose names could be secured. Forty-seven complete replies were received which gave reports on nine different makes of garden tractors. Of these forty-seven owners, one purchased in 1923, two in 1924, seven in 1925, eight in 1926, eight in 1927, eleven in 1928, and ten in 1929.

Following is a list of operations performed by garden tractors on Long Island as reported by owners:

Cultivating, plowing, harrowing, lawn mowing, planting or seeding, opening rows for planting, hauling wagon or trailer, working up poultry runs, covering rows after planting, marking out rows, ridging up row crops, weeding, field mowing, transplanting, spraying, cultivating orchard, leveling, digging potatoes (small plow-type digger), sawing wood, operating concrete mixer, operating snow plow, hauling logs, pumping water, cutting ensilage (small type feed cutter), grinding feed. The list is arranged as nearly as possible according to the number of owners reporting each operation. Cultivating is the most common operation, plowing next and so on throughout the list. The first five are the major operations. Lawn mowing is a very common one.

The following questions and answers obtained from the questionnaire referred to are especially interesting:

1. How does the quality of work done with your garden tractor compare with that of horse-drawn or hand-operated implements?—25 report better; 8 report just as good; 3 report not as good; 7 not reporting; 3 report cultivating not as good as with horse.

2. Can you cultivate as close with the tractor as with horse or hand-operated implements?—32, yes; 3, no; 8, not reporting; 4 replied that they could cultivate as close with the tractor as with horse-operated toools, but not as close as with hand-operated tools.

3. Can you accomplish work faster with the tractor than with other means?—35, yes; 5, no; 7, not reporting.

4. Do you find the tractor satisfactory for cultivating ridged row crops?—24, yes; 2, no; 21, not reporting, as they raised no ridged row crops.

5. Do you consider it necessary to have the tread (distance between drivewheels) adjustable in width so as to adapt the tractor to various widths between rows?—11, yes; 20, no; 16, not reporting.

6. Approximately how many days per year do you use your tractor?—Average of all reporting, 89.0 days per year. (NOTE: Not necessarily full days, but days on which the tractor is used. This is a surprisingly large total, indicating that the garden tractor is in almost daily use throughout the growing season.)

7. Do you consider your machine reliable and dependable?— 40, yes; 3, no; 4, not reporting.

8. What is your approximate annual cost for repairs? —Average of all reporting, $12.31, based on reports on 17 machines, which had been used an average of three years each.

9. Do you consider the garden tractor a good investment on your place?—41, yes; 2, no; 4, not reporting.

OWNERS' OPINIONS

Owners were asked to "list and describe difficulties experienced in operation, faults in construction, weak or defective parts, motor troubles, clutch troubles, difficulties with chains or gears in final drive, etc." The following troubles were mentioned:

1. Slippage of drivewheels
2. Breakage of drive chain
3. Exhaust located so that it damages plant
4. Drivewheels clog up between lugs
5. Spark plugs break easily from vibration and need replacement about every month
6. "Needs a mechanic to operate it"
7. Drive chains jump on rough ground
8. Very hard to turn at the ends of the rows
9. Dirt gets into magneto
10. Tractor tips over easily
11. Gasoline leaks onto spark plug and muffler and catches fire.

The question, "In your opinion, what changes or improvements in design would make it possible to secure better results from your machine?" resulted in the following suggestions:

1. Leaf guards or vine turners
2. Larger, more efficient lugs
3. Better method of raising and lowering cultivator teeth
4. Diverson of exhaust gas from plants and operator
5. Better oiling system
6. Better starting or cranking method
7. Should be equipped with reverse speed
8. Should have lower center of gravity
9. Needs self-starter.

Returns from the 47 owners whose replies to the questionnaire were complete, indicate that the garden tractor is finding a wide field of usefulness on Long Island. A great majority of those who own fairly recent models are well satisfied with their machines and consider them a good investment. Conditions here are favorable to their use. Most of the land is level and quite free from stones and rocks. The soil is usually a light sandy loam which is easily worked.

I shall attempt to classify the garden tractors that are on the market this year. These may be divided into three distinct classes or sizes: (1) Large garden tractors, (2) small power cultivators, and (3) general-purpose garden tractors. (It is a question whether these are well named, but they are between the other two and to a considerable degree fulfill the requirements previously set up.)

Large Garden Tractors. The capacity of machines of this class is indicated by the following approximate specifications and ratings, which are the result of observation of their use under Long Island conditions:

1. Engines of 5 to 12 horsepower (usually 2 cylinders)
2. Riding models
3. Pull one 12-inch plow to a depth of 7 inches and at the rate of about 2 acres per day under favorable conditions
4. Operate three 30-inch lawn mowers
5. Operate a five-foot field mower
6. Operate a five-foot single-disk harrow
7. Gasoline consumption 4 to 6 gallons per day (approximately)
8. Limited to 24-inch rows—weight, 1250 pounds.

There is only one manufacturer of this class this year.

If from 6 to 10 acres is to be plowed each year, much deep cultivation of wide-row crops (24 to 36 inches) and other work of this type, a machine such as described in this class would seem to be the logical selection. This will mean a sacrifice of the facility for cultivating narrow row crops (10 to 18 inches) and will require more headland and turning space than for the smaller machines.

Small Garden Cultivators. Their specifications and ratings are as follows:

1. One to two-horsepower engines, usually single cylinder
2. Walking models
3. Twenty-two to 30-inch lawn mower
4. Four to 8-inch plow (mostly used for hilling up or opening rows for seed, although some models do light garden plowing in a very creditable manner)
5. One 3-foot section spike tooth harrow
6. One 3-foot Acme harrow
7. Gasoline consumption 1½ to 2 gallons per day (approximate)
8. Will cultivate 12-inch rows.

There were eight manufacturers of this type of machine this year

One of the accompanying illustrations shows a single-drivewheel garden cultivator. We have found this type well adapted to cultivating nursery stock where it is necessary to work between rows that would be too high to straddle.

Where the cultivation of narrow-row market garden crops forms the main part of the work, a machine of the type described under this class should be considered. It is light in weight and easily handled in close cultivation but does not have sufficient power for heavier jobs such as plowing.

General-Purpose Garden Tractors. I hesitate to include machines in this class without qualification. Some fall short because they are not adapted to narrow-row work. Others will not handle more than an 8-inch plow, and this is not quite big enough for satisfactory plowing, but they do come close to answering the requirements. Their characteristics are as follows:

1. Three to four-horsepower motor, usually single cylinder
2. Walking models usually
3. Eight-inch plow—capacity, one acre per day (approximate)
4. Three and one-half foot field mower—will cut at rate of 3 to 4 acres per day
5. Twenty to 22-inch wood saw
6. Thirty to 36-inch lawn mower
7. Gasoline consumption, 2 to 3 gallons per day (approximate)

There are five manufacturers in this class this year, all of them making their own engines.

Where only 3 or 4 acres is to be plowed and the widths between rows can be adapted to the tread, it is quite possible that the general-purpose type of garden tractor will fit in to very good advantage. It will give power for cultivation and all row-crop work, and a considerable acreage of light plowing. With an 8 to 10-inch plow a tractor of this type will plow an acre or more a day under favorable conditions.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

The Grindrod Impact Sterilizer, G. J. and A. M. Hucker (New York State Station (Geneva) Technical Bulletin 155 (1929), pp. 31, figs. 3).—This method of sterilizing milk, which consists of superheating milk under pressure with a finely-divided jet of steam, has been studied, using milk cultures of pure strains of organisms of known heat resistance as well as uninoculated milk which has been allowed to develop a heat-resistant flora.

When held at 230 degrees (Fahrenheit) for 1 or 2 minutes all of the nonthermophilic organisms were eliminated from the milk. Holding at 240 degrees for 3 to 5 minutes was necessary to reduce all the thermophilic heat-resistant types of bacteria.

This method destroys the cream line of milk, and its use in the market milk field may be confined to semitropical and tropical conditions where sterility is essential. However, the process may be adapted to the sterilizing of fluid milk to be made into condensed, evaporated, or dried milk. The method gives a slight "boiled" flavor to the milk, and also precipitates albumin at high temperatures. On the other hand it is a rather rapid process, and removes in certain cases dissolved odors and flavors.

The Fatigue Properties of Cast Iron, J. B. Kommers (American Society of Testing Materials (Philadelphia) Proceedings 29 (1929), pt. 2, pp. 100-108, figs. 2).—The results of studies conducted at the University of Illinois and University of Wisconsin on the fatigue properties of 14 lots of cast iron are reported.

The Illinois tests included tension, compression, Charpy impact, Brinell hardness and rotating-beam fatigue tests. The fatigue strength of cast iron was found to be markedly increased by often repeated stress below the endurance limit. Grooves in cast-iron test specimens reduced the endurance limit only a small amount. The fatigue, tension and Brinell hardness tests were made at high temperatures, and there was no great reduction in these values up to a temperature of about 800 degrees (Fahrenheit).

Tests on range of stress showed that the endurance limit for stresses from zero to a maximum tension were 1.48 times the endurance limit for completely reversed flexural stress. Formulas are given by means of which the maximum unit stress for various ratios of minimum to maximum stress may be computed approxiamtely.

The Wisconsin tests included tension, compression, transverse, Russell impact, Rockwell and Brinell hardness and the rotating-beam fatigue tests. The materials ranged from low strength to high strength cast irons. The ratio of endurance limit to tensile strength showed an average value of 0.49, and the ratio of endurance limit to modulus of rupture showed an average value of 0.26.

Machineability of Cast Iron E. J. Lowry (American Society of Testing Materials (Philadelphia) Proceedings, 29 (1929), pt. 2, pp. 126, 127).—It is pointed out that, although machineability of cast iron is a function of abrasion, hardness, and ductility, hardness alone can not be considered as a true indicator of machineability since it does not measure the abrasive quality of the metal. Any influence which tends to eliminate abrasiveness increases machineability, such as annealing, higher silicon content, higher carbon content, or the addition of nickel, titanium or any other softening alloy.

The Static and Fatigue Properties of Some Cast Irons, J. B. Kommers (American Society of Testing Materials (Philadelphia) Proceedings, 28 (1928), pt. 2 pp. 174-197, figs. 15).—This paper reports the results obtained in the testing of ten series of cast iron at the University of Wisconsin. The tests included tension tests on two different sizes of specimens, and compression, impact, transverse, hardness and fatigue tests. Special attention is drawn to the effects of nickel and chromium additions.

The results showed that while the fatigue endurance limits of cast irons may be roughly estimated from properties such as tensile strength, hardness, modulus of rupture, and the like, the knowledge of the effect of available factors in influencing the properties is so meager that such approximate estimates of endurance limit should always be checked by direct experiment. No consistent relation was found between endurance limit and chemical composition.

Wear Testing of Cast Iron, A. L. Boegehold (American Society of Testing Materials (Philadelphia) Proceedings, 29 (1930), pt. 2, pp. 115-125, figs. 4).—A review is given of investigational work which has been done from time to time on the wear testing of cast iron. It is pointed out that there is no agreement between various investigators as to the method of testing for wear of cast iron, nor in their opinions regarding the influence of various elements in cast iron upon resistance to wear. A method of test is described relating to the wear testing of cast iron for automotive engine cylinder blocks. The results of a second test using individual cylinders of four different kinds of cast iron, showed that the kind of cylinder iron used had no influence upon the result because of good lubrication between the piston and the cylinder.

The conclusions reached are that a universal wear test is undesirable, but that laboratory wear tests in which service conditions are imitated produce valuable data. It has been found that wear testing with lubricants present is difficult.

Studies in the Electrodeposition of Metals, D. B. Keyes and S. Swann, Jr., (Illinois University (Urbana) Engineering Experiment Station Bulletin 206 (1930), pp. 18).—The results of studies on the electrodeposition of several different metals are reported.

The results indicate that the successful deposition of amphoteric metals must take place from highly ionized complex compounds. Aluminum was found to be the only metal which could be electrodeposited from the complex formed with tetraethyl ammonium bromide and its halide. It was found necessary to use the bromide for successful deposition of aluminum. Cerium, vanadium, chromium, and tungsten halides were found to form complexes only above the decomposition point of tetraethyl ammonium bromide on account of their high melting points.

An appendix deals with a method of electroplating small objects with aluminum.

Impact Testing of Cast Iron, H. Bornstein (American Society of Testing Materials (Philadelphia) Proceedings, 29 (1929), pt. 2, pp. 109-114).—This is an analysis of the impact testing of cast iron, with particular reference to its use in farm machinery. It is pointed out that no standard method of test has been developed. While there appears to be some disagreement between investigators, it is stated to be the consensus of opinion that irons high in static strength are also high in impact value. In many cases, it is pointed out the impact test is of greater value in predicting results in service than are static tests, especially where the casting is to be subjected to shock

Heat Transfer Through Insulating Materials, M. S. Van Dusen and J. L. Finck (American Institute of Refrigeration Proceedings, 17 (1928), pp. 137-150, figs. 5).—The results of tests conducted by the U. S. Bureau of Standards of the heat transfer through several of the newer insulating materials are reported, and the method of testing is described in detail.

With the exception of the gypsum products the results indicate conductivity as a function of density, irrespective of material. As the density becomes very low the conductivity in general tends to approach a value varying very little with density. The materials giving this trend all consist of loosely packed fibers. The gypsum products follow a distinctly different trend, since the cell walls are practically continuous from one portion of the material to another and are composed of fairly good conducting material. The conductivity decreases rapidly with decreasing density. Air motion from one cell to another is evidently of negligible importance even with the lightest material.

All materials of the class considered contained a certain amount of hygroscopic water, tending to be in equilibrium with the relative humidity of the surrounding atmosphere and practically independent of the temperature. Ordinary changes in the humidity were found to change the normal moisture content by relatively small amounts and to produce insignificant or at least small changes in the thermal conductivity of the material. The observed large increases in the conductivity of slightly damp materials are considered to be due to evaporation of water during test and the consequent absorption of relatively large amounts of heat within the material. The results indicate that the effect on thermal conductivity is of the same order as the effect of changing the bulk density of the material the same amount by other means.

Comparative Strength Properties of Woods Grown in the United States, L. J. Markwardt (U. S. Department of Agriculture, Technical Bulletin 158 (1930), pp. 39).—This bulletin

supplements but does not supersede U. S. Department of Agriculture Bulletin 556. It gives data on weight, shrinkage, and strength of woods grown in the United States, including exact information for the comparison of the strength properties of many native species.

The Effect of Clay as an Admixture in Concrete, A. N. Vanderlip and H. H. Scofield (Cornell Civil Engineer, (Ithaca, N. Y.) 38 (1930) No. 5, pp. 104-108, 119, figs. 6).—This is a preliminary report of experiments in progress at Cornell University. Tests are being made on 4 series of concretes at ages of 60 days, 6 months 1 year and 2 years. The present report covers the results of the 60-day and 6-month periods only.

It was found that, within the range of the tests, the strength of the resulting concrete is reduced by replacing 10 per cent of the cement by an approximately equal weight of clay. At the 180-day age especially, the strength of specimens stored in comparatively dry air was considerably less than that of water-cured specimens. This indicates the value of keeping concrete moist during curing, and also suggests that the alternate freezing and thawing of concrete that has previously been cured under favorable conditions have little effect upon the strength of the concrete.

The modulus of elasticity at 800 pounds per square inch stress is reduced by replacing 10 per cent of the cement with clay.

The results of the permeability tests under water pressure appear to indicate that 10 per cent of clay decreases considerably the permeation of water into and through the concrete in the leaner 5-bag batch concrete, but substantially increases the permeation in the case of the richer 6-bag batch concrete. In some cases a plugging action of the clay was noted.

A partial bibliography is included.

Some Additional Factors in the Prediction of the Tensile Strength of Sand Mortars, H. W. Leavitt, J. W. Gowen, and W. S. Evans (Maine University, Technological Experiment Station (Orono) Bulletin 24 (1930), pp. 12, fig. 1).—These experiments led to the conclusion that the mechanical analysis data, the percentage of mixing water, and the colorimetric test for organic impurities of sands give valuable information for the prediction of the 28-day tensile strength of sand mortars. Other important factors must be measured, however, in order to make more accurate predictions.

The Use of Calcium Chloride or Sodium Chloride as a Protection for Mortar or Concrete Against Frost, W. N. Thomas ([Great Britain] Department of Scientific and Industrial Research Building Research Special Report 14 (1929), pp. IV + 30).—Studies are reported which showed that both calcium chloride and sodium chloride when added in suitable proportions to the mixing water of a portland cement mortar or concrete afford protection against a limited degree of frost during the early setting and hardening periods. Sodium chloride is liable to cause efflorescences on the face of the concrete, and calcium chloride tends to produce discolorations.

Unless the concrete is very dense, the presence of commercial forms of both salts in reinforced construction is liable to cause corrosion of the reinforcing metal, and particularly to intensify that due to stray electric currents. It is considered inadvisable to use either salt for this purpose. Concrete to which sodium chloride is added appears to attain a considerably lower strength at long ages than similar concrete without this salt. It appears that the best proportions of calcium chloride to use are from 2 to 4 per cent of the anhydrous salt by weight. Certain experiments have shown, however, a decrease in strength, particularly of tensile strength, thus indicating that the employment of calcium chloride is attended with some risk.

A bibliography is included.

Some Permeability Studies of Concrete, F. R. McMillan and I. Lyse (Journal of American Concrete Institute (Detroit), 1 (1929), No. 2, pp. 101-142, figs. 20).—The tests reported in this paper were undertaken at the research laboratory of the Portland Cement Association for the special purpose of studying the water-tightness of concrete mixtures as part of a general investigation covering the factors affecting the durability of concrete. A method of making permeability tests quickly and easily was developed. The test results show that this test is very sensitive.

Minor defects in concrete that would have no appreciable effect on the compressive strength affect the flow of water through the concrete under pressure to a marked degree. Defects in placing appear to be much more important in the leakage than the ordinary differences in mixtures, materials or water content. The most significent results show the effect of continued moist curing in increasing the water-tightness of concrete.

It was demonstrated that for all the ordinary mixes encountered in practice the usual 28-day moist curing at 70 degrees (Fahrenheit) produced concrete through which no water would flow under pressures up to 120 pounds per square inch. Tests using shorter moist-curing periods showed very rapid increases in water-tightness with increases in length of moist-curing periods, which held regardless of other factors of the tests. The results showed also the importance of quantity of mixing water in water-tightness, this being second in importance only to the length of moist curing. An increase in the quantity of mixing water was accompanied by a reduction in water-tightness, regardless of the curing period or the characteristics of the cement used. For the equivalent of 3 days' moist curing at 70 degrees, concrete and mortar with a water-cement ratio of 5 gallons per sack or less showed no leakage of water under pressures up to 80 pounds per square inch. For an equivalent of 7 days' moist curing at 70 degrees the water ratio necessary to produce such complete water-tightness was found to be 6 gallons per sack. Water-cement ratios of 9 gallons per sack produced complete water-tightness for 28 days' curing.

The results also showed that after test specimens were removed from the saturated atmosphere of the moist room and placed in the atmosphere of about 50 per cent relative humidity there was practically no increase in water-tightness. This was true of specimens tested at various periods up to 6 months. This result is taken to indicate that progressive building up of the internal structure of the concrete by curing can not take place unless moisture is present for the continued chemical reactions.

The tests using cements of different characteristics showed that the development of water-tightness at the early ages was comparable with the development of compressive strength. Those cements which gained their strength rapidly during the first few days were found also to gain water-tightness more rapidly. Studies of some of the common powdered admixtures showed that additions of those materials which required extra water to maintain plasticity reduced water-tightness, while with those materials which required no extra water there was some slight improvement. The changes brought about by these additions, however, are quite insignificant in comparison with the effects produced by a few days' change in the period of moist curing or a moderate reduction in the water content.

The results of the freezing and thawing tests showed the marked advantage of a low water-cement ratio in increasing the resistance of concrete to freezing.

Heat Insulators, E. Griffiths ([Great Britain] Department of Scientific and Industrial Research Food Investigations, Special Report 35 (1929), pp VIII + 96, pls. 3, figs. 34).—Investigations are reported on the thermal conductivities of several different types of insulating materials throughout the range of temperatures ordinarily met with in cold storage. The methods used are described, and a brief account is given of work relating to the absorption of moisture by such materials, to their inflammability, and to their structural strength.

The conclusion is drawn that the value 0.0001 c. g. s. units or 0.29 B. t. u. per square foot per hour per inch thickness for 1 degree (Fahrenheit) difference of temperature between the faces may be taken as representative of the thermal conductivity of insulating material of good quality. Most of the samples of slab cork of good quality tested showed the conductivity to be a little less than 0.0001 c. g. s. Finely granulated cork after baking to a dark brown color was found to be a decidely better insulator than the raw material, the difference being of the order of 13 per cent. Coarsely granulated cork was a less good insulator, because it permitted convection currents in the interspaces between the granules. In this connection it was found difficult to distinguish heat transfer by convection from that by conduction.

Cork wool or cork shavings made remarkably good insulators which had the additional merit of lightness, weighing only 3.3. pounds per cubic foot. In practice it is necessary, however, to protect this material from moisture. Dry charcoal was found to be a good insulator, but its moisture-absorbing properties were considered to be a serious drawback to its use for cold storage insulation.

Slag wool or silicate cotton showed a conductivity which is dependent to a marked degree upon the density of packing, decreasing with increasing density to a minimum and then increasing with increasing density.

The results obtained with cellular expanded rubber illustrated the advantages of a material made up of an assemblage of minute air cells bounded by membranes. When shredded, this material was decidedly less efficient than when in the sheet form, this being due apparently to the relatively large air spaces between the pieces into which the material was cut up. Of the various timbers studied the light wood commonly called balsa was found to combine efficiency as a heat insulator with some facility for being cut into shape by carpenters' tools. However, it is soft and easily damaged by blows, and a thin covering of harder material is necessary to make it suitable for the construction of doors and the like. The moisture-absorbing capacity of this wood is also high.

Both crude diatomaceous earth and pumice in granular form showed conductivity coefficients of the order of twice that of slab cork, and were found to weigh about 30 pounds to the cubic foot. Certain varieties of compressed peat, dried and treated, showed a thermal conductivity as low as cork, but the moisture-absorbing capacity of these materials presented a considerable drawback to their use for cold storage insulation.

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Agricultural Engineering the World Over

THERE are in the world 196 public institutions at which agricultural engineering teaching or research is carried on, according to the International Institute of Agriculture, which published, as a contribution to the recent International Congress of Agricultural Engineering, a list of these institutions with their agricultural engineering personnel and subjects covered. The geographic distribution and some of the characteristics of these departments are worth noting.

In Europe twenty-three nations employ 193 trained agricultural engineers in 106 departments. The Soviet Republics, taken as a group, lead with 21 departments and are closely followed by Germany and Italy. Germany, with 34 agricultural engineers has a larger personnel, in fact,, than the Soviet Republics. Even such small countries as Esthonia and Letonia give academic attention to the subject.

It is interesting to note that in the United States practically the same number of agricultural engineers as in all of Europe, 194 to be exact, are employed in public institutions, not counting the U.S.D.A. But instead of being scattered over 106 organizations they are employed in only 41 separate institutions. This greater concentration of personnel would seem the more conducive to progress. Some of the European countries, however, have at least one large, well-manned and equipped agricultural engineering department capable of doing important work and also of exercising leadership over numerous smaller departments.

Some other countries giving notable attention to agricultural engineering teaching and research are Canada, India, Japan, the Union of South Africa, and Australia.

A review of the classified schedule of subjects given indicates a close agreement the world over as to the recognized field and subject matter of agricultural engineering. Naturally the agricultural engineering of the world is broader than that of any one country, but the listing of subject matter shows it broader than that of the United States only in attention to crops we do not raise, to more primitive agricultural conditions than are common here, and to problems which are here taken care of by other branches of engineering.

Journal Possibilities

READERS of and contributors to this publication may well take stock of the purposes and opportunities of an engineering society journal in the crowded field of publication, as reiterated on occasion of the advent, in October, of "Civil Engineering," the new official journal of the American Society of Civil Engineers.

From an analysis of present conditions, the experience of other engineering societies, and the musty archives of nearly eighty years of organized existence the civil engineers have found justification for "a vigorous presentation of new ideas in the field . . . . . " The medium, their new society journal, will emphasize basic principles and advances in practice; the "underlying factors accounting for progress in the art," in articles on engineering data, analyses, theory and practice.

J. F. Coleman, president of A.S.C.E., expressed its viewpoint on its new publication informally as follows:

> "With a freer style than was suitable for 'Proceedings,' it will take over from that publication the portion susceptible of a treatment characterized by brevity and vivacity. It will be the medium of communication with the membership on Society activities; technical, professional, and administrative. It will deal with those interests of the civil engineer that become vibrant as a consequence of the new 'Functional Expansion Program.'
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> "Such a transfer to a publication with a more facile style, with attractive type, with non-transparent paper, and with clearer illustrations, will offer marked advantages. . . . .
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> "Civil Engineering is to be the work of its contributors, primarily members of the Society, and as such will be just what the membership makes of it."

The editorial pages of "Mechanical Engineering" for November echoed approval of the new venture and added, on the subject of engineering society journals in general, the following:

> "The journals of engineering societies are the focal points of the professional interests of the engineers they reach, and the interpretative mediums by which engineering is related to the other phases of human culture and contemporary progress. They should provide the means which no other type of journal can apply so effectively by which engineers, having widely diversified technological interests and professional functions, may find themselves and their work brought into proper perspective with other engineers and their works and with the great forces—economic, technological, sociological, political, and cultural—which are molding contemporary civilization and affecting the destinies of men and nations. If this seems to be an ambitious function, it is none the less important, and if it is not performed by the journals of engineering societies, it is not likely to be performed by any other form of publication.
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> " . . . . . The American Society of Civil Engineers is adding to its already distinguished record of services to mankind an evidence of vigorous leadership in the common purposes of its members as men and citizens as well as engineers."

Like "Civil Engineering," AGRICULTURAL ENGINEERING is the work of its contributors and is just what A.S.A.E. members make of it.

If it is to embody a vigorous presentation of new ideas in its field; if it is to live up to its opportunity and obligation to bring each agricultural engineer and his work into proper perspective with other engineers and their work and with the other great forces which are "molding contemporary civilization," contributors and readers must keep these aims in mind. Even above the careful preparation of manuscript which this implies, it is important that you keep on the lookout for and be aggressive in preparing and submitting any material which might contribute to the good work. There will not be space to publish it all, but, on the other hand, there is no reflection on the quality of writing which is not published and a large selection of articles helps the editors to turn out, for you, the best journal it is in their power to produce.

Research and the Stations

OPPORTUNITY, in the form of agricultural engineering research, is knocking at the door of the engineering experiment station. R. W. Trullinger, president and leading research authority of the American Society of Agricultural Engineers, made this plain to an audience of engineering educators and research men in a paper presented before the Engineering Section of the Association of Land Grant Colleges and Universities which met in Washington last month.

Research has revealed again and again that the answers to common everyday problems are more deeply hidden in nature than is ordinarily apparent or suspected. That is the situation in agricultural research which admitted agricultural engineering to the agricultural experiment stations and which will also open to it the doors of the engineering experiment stations.

Agricultural research began when the early professors of agriculture became dissatisfied with the empirical knowledge of their day. As agricultural investigators have delved deeper and deeper in search of the answers to agricultural problems they have specialized and developed new sub-sciences and branches of science. They have found in comparatively simple problems occasion for detailed, controlled, and coordinated investigations along several specialized lines.

In the course of this development the agricultural investigators have run into complicated physical problems both in their research technique and in getting their results applied in common agricultural practice. They have found the agricultural engineer helpful in providing ways and means of controlling physical conditions for their experiments. But what is more important — they have found him indispensible in providing for the farmer the materials, equipment and methods for meeting specific agricultural requirements which they lay down. Upon the agricultural engineer depends the ultimate effectiveness and value of a large part of the federal and state agricultural research programs. So they have taken him into their exclusive but ever widening circle of specialists capable of contributing to the solution of agricultural problems.

Like the men who make profound studies in science to determine specific agricultural requirements, agricultural engineers often have to make extensive original studies in engineering to learn the means of meeting those requirements. As cited by Mr. Trullinger, some improvement in the results and power consumption of tillage operations has been affected simply by improved management, but soil and crop scientists have produced knowledge of tilth requirements which will make possible still further progress in tillage, as soon as agricultural engineers have been enabled to carry the study on toward its logical conclusion. They need to translate the tilth requirements into terms of soil technology, then into terms of soil dynamics or engineering properties. Then a study of such design factors as shape, size, strength, sharpness and metallurgical characteristics with relation to draft and to accomplishment of the desired result will provide a scientific basis for design and make available to farmers implements far superior to those of the present.

More and more light is continually being thrown by agricultural workers on the requirements and economic limitations of farm dwellings, animal shelters, dairy buildings and storages. In animal shelters and crop storages, for instance, there are physiological, pathological and biochemical requirements as to temperature, air supply, air movement and humidity. Before the shelter and storage requirements of specific farms can be economically met by the manipulation of structural mechanics and properties of materials, agricultural engineers will have to study materials, heating and ventilating equipment, temperature, humidity, and physics of air movement under a wide variety of conditions.

Rural electrification started as a problem of applying available electrical engineering knowledge and equipment. It has already progressed far enough to show possibilities of applying electricity to strictly agricultural uses in, for example, the farm processing of farm products, disease and insect control, animal nutrition, crop stimulation, poultry production and field draft operations. Here again it is the function of the agricultural scientist to determine requirements and of the agricultural engineer to meet them.

Land reclamation is an old field of activity with a largely empirical basis. Agricultural engineers have made a start toward an engineering study of the crop, soil and climate requirements laid down by soil and crop specialists. Here again agricultural engineers add to agricultural research the final touch which enables the farmer to put its recommendations into practice.

It is evident that research of this type, involving engineering physics, mechanics, metallury, kinematics, fuel technology, thermodynamics, structural mechanics, materials of construction, electrodynamics, hydraulics and similar subjects, occupies a peculiar administrative position. It is needed by agriculture, but it could be conducted with greatest facility and economy of public funds by agricultural engineers working in engineering experiment stations.

The agricultural and engineering experiment stations have grown up separately. Their facilities and techniques differ widely. But in their function of running down answers to the problems of agriculture and of industry their fields of usefulness have been found to overlap. In this they have grown together. To put it briefly, each needs both.

The path of progress leads in the direction of overcoming precedents and administrative difficulties to enable both the agricultural and engineering experiment stations to be of greatest possible usefulness to the public which pays for their support. The Engineering Experiment Station Bill, presented in the last session of Congress and still waiting to be acted upon, would give engineering experiment stations the opportunity and encouragement to become highly useful to agriculture. Some such provision will surely be made sooner or later. That the immediate passage of this bill would not be premature from the standpoint of agricultural engineering development is incidentally shown in these closing paragraphs of Mr. Trullinger's address:

> "However, the striking fact that practically a fourfold increase has occurred in the wealth produced per agricultural worked during the past 20 years since agricultural engineering has been recognized as a distinct branch of engineering would seem to indicate that the agricultural engineer, the man trained basically in some branch of engineering and sufficiently trained in agriculture to fully and intelligently recognize its basic industrial requirements, is the most important single factor in agricultural engineering research. A personnel well trained in agricultural engineering, as such, is essential to the success of research in the subject.
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> "There are already in existence several hundred projects of research and investigation in agricultural engineering at the land-grant research institutions. In a considerable number of these projects the distinctly engineering features have been organized by agricultural engineers and are ready to go, but appear to be prevented from making the desirable rapid progress largely on account of the naturally limited facilities for physical and engineering research available in the average agricultural experiment station. In such cases it would seem that about all that is needed is action by the engineering experiment stations.
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> "In substance, it seems safe to say that a well-rounded program of research on the distinctly engineering features of the application of physical and engineering principles to the practices of the industry of agriculture is available and ready to be put into effect in large part on short notice, and that the nucleus of an agricultural engineering research personnel is available to get it under way."

A. S. A. E. and Related Activities

Power and Machinery and Structures Divisions Reveal Technical Problems and Progress at Chicago Meetings

A MORE definite assurance than ever that agriculture must be radically reorganized for lower production costs, and a clearer understanding of the part agricultural engineers will play in bringing about that reorganization, pervaded the atmosphere of the technical meeting of the Power and Machinery and the Structures Divisions of the American Society of Agricultural Engineers, held this year at the Stevens Hotel in Chicago, December 1, 2 and 3.

The farm management program on the first day directed emphasis to the immediate problems of the aplication of engineering to farm production. This outlook on agricultural engineering as a means to improved economic conditions and living standards in agriculture, rather than as an end in itself, carried over into practically every paper and discussion in each of the division meetings the following two days.

Speaker after speaker in the farm management sessions pointed to the need of lowering farm production costs and to agricultural engineering as an important factor in accomplishing this. They were not overly optimistic about the future of large-scale farming or of agriculture in general. They have had first-hand experience with serious problems on which they have been able to obtain little help, and with conditions beyond their control which have and are apt at any time to change the hope of profit into loss. Two of the speakers admitted frankly that their operations this year have lost money. But they know their costs and the problems which must be solved before those costs can be lowered. They brought to the meeting problems which they hope agricultural engineers will help them solve, as well as information on solutions and partial solutions they have already worked out for some of their difficulties.

D. Howard Doane, proprietor of Doane Agricultural Service, arranged the farm management program and as chairman was successful in starting and closing each session on time, allowing each speaker sufficient time, providing time for discusssion and keeping everybody satisfied with the meeting. When the afternoon session adjourned at four o'clock most of the audience stayed in the room talking farm management informally among themselves for another hour or so, then hurried out to have dinner and get back in time for the opening of the evening session at seven o'clock. After the evening session adjourned at nine o'clock they again stayed for a couple more hours of this informal discussion in small groups.

When called upon to say a few words to the farm managers, R. W. Trullinger, president of the Society, told them of the growing strength of the Society and of its growing influence in national affairs.

A motion made, seconded and passed indicated that those interested in farm management would like to see a definite farm management group organized within the Society to promote progress in the engineering end of the work and to cooperate with other farm management organizations.

Well over one-half million acres of crop land were represented by the farm managers present, according to a hasty census taken during the afternoon session. More than 150 persons, including both farm managers and agricultural engineers who came to learn the large-scale operator's viewpoint on agricultural engineering problems, registered on this first day of the meetings.

Of special significance in the second and third days of the Power and Machinery Division meeting were the contributions on the relation of machinery and terracing; the attention given to machinery for special crops, including beets, cotton and corn; the symposium on general-purpose tractor development, and the interest shown in standardization. It was revealed that the increase in terracing in recent years warrants more attention being given to the improvement of terracing machinery and to the design of farm machines which will operate over terraces effectively, with facility and without injury to the terrace. A concerted effort is being made to mechanize sugar beet production, according to the speakers on the subject. Progress in power take-off standardization is covered in a separate item in this issue.

The paper on foreign standardization of agricultural machinery submitted by John Gaillard, mechanical engineer, American Standards Association, urged American cooperation in the movement toward international standardization of agricultural machinery. Col. O. B. Zimmerman, chairman of the Power and Machinery Division and an authority on farm equipment standardization, argued the other side of the question. He pointed out that the philosophy of standardization among engineers in America differs materially from that of European engineers. Here we favor less detailed standardization than is advocated in Europe, and more freedom for the designer. He suggested therefore that, while we might well indicate an interest in international standardization, we should not become committed to a program which would go beyond American standardization policy.

The Structures Division meeting showed indications that this Division is a step nearer to knowing what it wants and how to go about getting it than at this time last year. Final reports were presented on the Division's dairy barn questionnaire project and on the U.S.D.A. farm structures research survey. Farm grain storage problems were presented from several different angles by a group of specialists who contributed to a symposium on the subject. Three papers gave special consideration to the farm house.

Throughout its meeting the Structures Division reflected the viewpoint that farm buildings, including farm houses, are a type of farm equipment and as such should be so designed, constructed and used as to contribute the maximum possible to the net income of a farm and to the satisfaction and well-being of the farm family. It was shown that practically all farm buildings need to be studied from this viewpoint. The various reports and papers presented gave some indication as to where further research should begin and how it should proceed. On Wednesday afternoon, the last session of the meeting, research received the full attention of the group. Their long and interested discussion made it apparent that they will not rest content until farm structures receive the attention in the U.S.D.A. and in the agricultural colleges and experiment stations which is justified by agriculture's investment in buildings. The Division adjourned without making definite plans for the further promotion of research as its next move depends on how the report of the "Farm Structures

Research Survey" is received and its recommendations acted upon by the public institutions and materials interests concerned.

Total registration for the meetings of both divisions was 225. Considering the effect that business depression has had on traveling allowances and on the attendance of many meetings, this figure is satisfactory and higher than might have been expected.

Additional Information on Reclamation Meeting

LATEST information on the coming A.S.A.E. Reclamation Division meeting in San Francisco, January 6 and 7, is that the price of the noon luncheon scheduled each day will be $1.50 and that tickets for the banquet on the evening of January 6 will be $2.50 each. The banquet will be strictly informal and ladies are especially invited to attend.

The Whitcomb Hotel, where the meeting will be held, is located on Market Street, at the Civic Center. Room rates from $3 to $6 per day. All rooms are provided with bath and all double rooms have twin beds. Requests for reservations should be addressed directly to the hotel.

No changes have been made in the program as announced in our November issue. The papers and discussions by authorities on various phases of reclamation work will be enlightening and inspirational to reclamation men, and at the same time will call public attention to the place of reclamation in sound policies of land and power utilization and flood control. It is expected that land reclamation men all over the country, and particularly from the West, will respond in large numbers to this opportunity to improve themselves professionally and at the same time help regain for sound reclamation activities the public respect and support which they warrant.

Power Take-off Standards Revision Put Up to Standards Committee

IN ABOUT thirty minutes one noon during the Power and Machinery Division meeting at Chicago the A.S.A.E. Committee on Power Take-Off put the finishing touches and its stamp of approval on a revised and enlarged set of power take-off standards and recommended practices which has been in process of development for more than a year. Committee members present voted unanimously to submit the revised standards to the Standards Committee of the Society as ready for adoption and publication as A.S.A.E. Standards.

The Society's standards on the subject were first established in 1927 and last revised in July, 1928. Progress since that time in the development and application of the power take-off on farm tractors and implements made the 1928 standards inadequate. Commercial development without standardization has minimized the value of the power take-off to farmers and at the same time has greatly complicated the problem of drawing up provisions and specifications acceptable to a majority of the interested manufacturers.

The committee arrived at an understanding only after numerous meetings and a great deal of test work by some of the committee members. Its recommendations cover the type of power take-off shaft end, means of retaining the fitting to the shaft, location of shaft, rotating speed and direction, drawbar length, safety of the operator, manufacturer's obligations to furnish parts, and all significant dimensions and tolerances.

W. L. Zink, chief engineer of the General Implement Company and chairman of the committee, presented a paper before the Power and Machinery Division meeting only a few hours after his committee had finally approved the standards, in which he explained in detail the test results and other reasons upon which the committee recommendations are based.

Present members of the committee on Power Take-Off are W. Leland Zink, (chairman), General Implement Co.; H. D. MacDonald, International Harvester Company; L. A. Paradise, John Deere Harvester Works; O. E. Eggen, Oliver Farm Equipment Company; S. M. Nahikian, Blood-Brothers Machine Co.; R. O. Hendrickson, J. I. Case Company; O. E. Jacobi, Allis-Chalmers Mfg. Company; L. J. Fletcher, Caterpillar Tractor Company; T. H. Oppenheim, New Idea Spreader Company; Dent Parrett; K. I. Moree, Massey-Harris Company; A. H. Gilbert, Rock Island Plow Company; and A. W. Lavers, Minneapolis-Moline Power Implement Company.

If the recommendations meet the approval of the A.S.A.E. Standards Committee, as is expected, they will be submitted to the Society membership for final vote on their adoption as A.S.A.E. standards and recommended practices. There is every reason to believe that they will be approved, will "hold water," be closely adhered to in the industry, and meet the manufacturers' and farmers' need for agricultural power take-off standardization for some time to come.

Motors Committee Report to be Published

FOR two years the A.S.A.E. Committee on Electric Motors worked to assemble the information needed by farmers to enable them to use electric motors with greatest possible profit and satisfaction. The two annual reports of this committee have been combined and entitled "The Selection, Installation and Operation of Farm Electric Motors." Orders for copies in printed form, to be delivered about the first of the year, are being accepted. A number of public service companies are placing quantity orders and plan to distribute the booklet among their rural customers. Some of the state project leaders are also placing orders for copies for use in their extension work.

As only a limited number of copies over the number ordered will be printed, it will be impossible to fill quantity orders received after the booklet is off the press. Such orders should be sent in immediately. Prices are based on a sliding scale, running from 25 cents per copy for less than 25 copies to $6.00 per 100 copies on orders of 500 copies or more. Single copies of the report in mimeograph form are available for inspection by anyone who may desire to place a quantity order.

The agricultural engineers who prepared the report are W. D. Hemker, Wisconsin Light and Power Co.; G. A. Rietz, General Electric Co.; Ralph Prater, Prater Pulverizer Co.; Ben W. Faber, Westinghouse Electric and Manufacturing Co.; and Frank J. Zink, Westinghouse Electric and Manufacturing Company.

American Engineering Council

DURING its two-day session, October 17-18, in Washington, D. C., the Administrative Board of American Engineering Council considered numerous committee reports and matters of concern to the engineering profession. A strong resolution supporting the action of the American Society of Civil Engineers in calling upon the United States Geological Survey for a prompt publication of water supply and other data secured by and through cooperation with the U. S. Geological Survey, was adopted.

The Board approved the program of the U. S. Coast and Geodetic Survey of the Department of Commerce, and requested appropriations for the purpose of extensive earthquake studies.

Upon the recommendation of the Flood Control Committee, the following resolution was adopted:

BE IT RESOLVED BY THE ADMINISTRATIVE BOARD OF AMERICAN ENGINEERING COUNCIL, That this body adheres to the opinion heretofore expressed that so much is involved in the Mississippi River flood control project, that before final commitment to the major engineering features of the project is made, the Chief of Engineers of the Army should have the benefit of the counsel of the best hydraulic engineering talent that the nation affords. In its judgment some of the present expenditures, even though warranted as partial protection, may not be effective in the plan finally adopted.

The Council understands that surveys and studies are now being made under the direction of the Chief of Engineers more nearly commensurate with the importance of the project than those attempted in the past; and recommends that he be heartily supported in such studies of the problem, and urges that Congress allow him ample time to perfect them before committing himself to a general plan.

Council wishes to emphasize the fact that there are not only engineering problems to be solved but also economic problems. Investigation may show that the value of some tracts of lands does not justify large expenditures for flood protection but that such lands should be taken over for reforestation under existing federal laws.

The date of the annual meeting of the Assembly was fixed as January 15-17 inclusive. The meeting will take place at the Mayflower Hotel where the annual banquet will be held January 16, 1931.

Necrology

H. B. Josephson, engineer in charge of agricultural engineering research, Pennsylvania State College, met with accidental death at Hamburg, Germany, in October. He was on sabbatical leave and was spending six months in Europe making studies of the artificial dehydration of forage crops. Mrs. Josephson waited for him in Berlin from October 16 to October 30, when she was notified that his body had been found in the harbor at Hamburg. He was apparently the victim of accidental drowning.

Mr. Josephson was raised on a large grain farm in western Canada and was graduated from the University of Saskatchewan in 1922. For two years he was an instructor in agricultural engineering at that institution and then went to Iowa State College to take advanced work in agricultural engineering and obtained his master's degree there in 1925. In the same year he became associated with the agricultural engineering department at Pennsylvania State College, where he has devoted practically ful time to the study of power and labor problems with special reference to lowering farm production costs. A series of six technical papers by Mr. Josephson, based on the results of his power and labor research studies, appeared in AGRICULTURAL ENGINEERING during 1928.

Mr. Josephson ranked high in the agricultural engineering profession. He was an outstanding research engineer in this field. His committee work in the American Society of Agricultural Engineers, his contributions to programs of Society meetings, and to publications of the Society, placed him in the ranks of one of the Society's most valued and able members. His loss will be keenly felt in agricultural engineering circles.

New A.S.A.E. Members

Howard H. Beningfield, technical representative, Cleveland Tractor Co., Cape Town, South Africa.

Everett B. Cushman, mechanical engineer, Food Machinery Corp., San Jose, Calif.

Ernest E. Einfeldt, chief engineer, French & Hecht, Davenport, Ia.

J. B. Fisher, chief engineer, Waukesha Motor Company, Waukesha, Wis.

Lionel W. Kirkman, student in experimental department, Cockshutt Plow Co., Ltd., Brantford, Ontario, Can.

Carroll F. Nelson, rural electrification, Niagara Hudson Power Co., Jamestown, N. Y.

Transfer of Grade

Carl G. Krieger, Jr., agricultural engineer, Ethyl Gasoline Corp, New York, N. Y. (Junior to Associate Member.)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the November issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Curtiss L. Cook, assistant designer, Syracuse Chilled Plow Co., Syracuse, N. Y.

Elgin C. Davis, U. S. Commissioner on land appraisement, East Prairie, Mo.

N. L. Simmons, vice-president, Kraft Phenix Dairies, Inc., Wausau, Wis.

Employment Bulletin

An employment service is conducted by the American Society of Agricultural Engineers for the special benefit of its members. Only Society members in good standing are privileged to insert notices in the "Men Available" section of this bulletin, and to apply for positions advertised in the "Positions Open" section. Non-members as well as members, seeking men to fill positions, for which members of the Society would be logical candidates, are privileged to insert notices in the "Positions Open" section and to be referred to persons listed in the "Men Available' section. Notices in both the "Men Available" and "Positions Open" sections will be inserted for one month only and will thereafter be discontinued, unless additional insertions are requested. Copy for notices must be received at the headquarters of the Society not later than the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. There is no charge for this service.

Men Available

AGRICULTURAL ENGINEER desires position as manager of an agricultural enterprise or with agricultural implement manufacturer. Has had 15 years experience in the development of large scale farming operations including both irrigation and drainage. College degree. MA-186.

AGRICULTURAL ENGINEER, degree from Ohio 1924. Associate member of American Society of Agricultural Engineers, one year with barn equipment company as draftsman and salesman, three years drainage specialist in middle western states, two and one-half years county agricultural agent, experienced in handling power machinery and equipment, organizing and handling labor, two years mechanic in United States army, desires permanent employment as extension engineer, position with a farm machinery company or agricultural enterprise. Willing to go anywhere; 33 years old, married, two children. MA-187.

AGRICULTURAL ENGINEER, with degree from middle western college 1930, also one-half work completed for masters degree. Experience in design and research in farm equipment with large manufacturing company. Farm experience. Can handle farm machinery or farm buildings work. College or experiment station work preferred. Age 23. Unmarried. MA-188.

MECHANICAL ENGINEER, for the past eighteen years engaged in design and development work on farm tractors, row crop cultivating equipment, and during the last four years specializing in corn harvesting machinery, and who has had extensive experience in design, development work and field testing, desires to make a new connection preferably with a farm equipment manufacturer. Member A.S.A.E. Age 43. Married. MA-189.

Positions Open

AGRICULTURAL ENGINEER, preferably a graduate in a professional agricultural engineering course and who may have had some experience in designing cultivators for row-crop tractors, is wanted by a well-established farm equipment manufacturer to design and develop a new type of cultivator for row-crop tractors. PO-174.